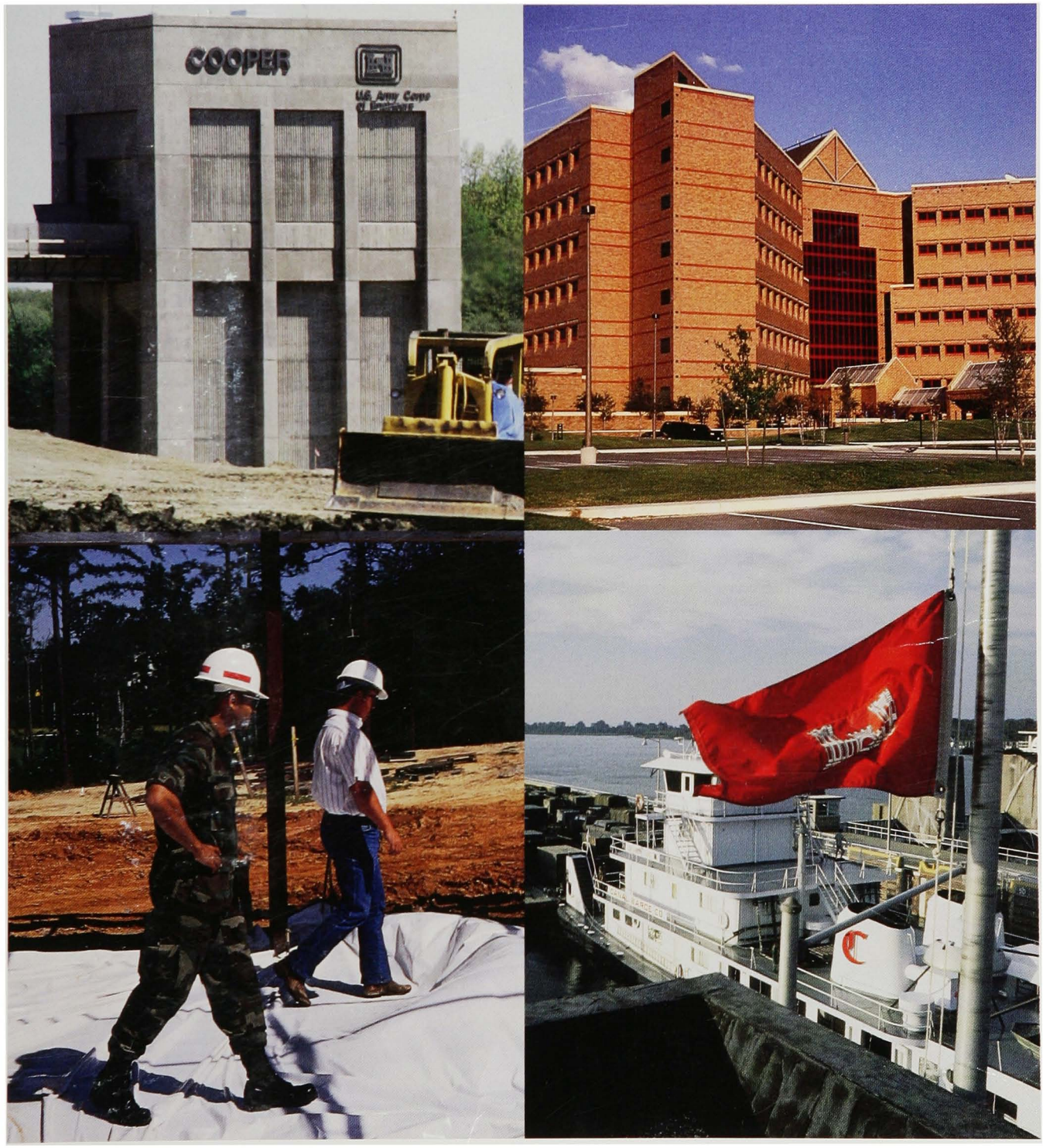
US Army Corps
of Engineers

The History of the Southwestern Division 1986 - 1994



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On the Cover (Clockwise from left): Cooper Dam under construction, Brooke Army Medical Center, military equipment move on the McClellan-Kerr Arkansas River Navigation System, inspection at Fort Polk, Louisiana.

PREFACE

During the late 1980s and early 1990s, personnel of the Southwestern Division (SWD) of the U.S. Army Corps of Engineers carried out their diverse responsibilities amid sweeping transitions for the entire organization. Based in Dallas, Texas, the division serves Texas, Oklahoma, New Mexico, Arkansas, southern Kansas and Missouri, and eastern Colorado for civil works, and New Mexico, Oklahoma, Texas, Arkansas and Louisiana for military construction and emergency management activities. The division's military construction activities ranged from strategic facilities for sophisticated defense aircraft in arid New Mexico to rehabilitating a major U.S. Army hospital in southern Texas. Its civil works varied from inland and coastal navigation projects in Arkansas and Texas to restoration of pre-Columbian irrigation systems in New Mexico. Major floods in Oklahoma, Arkansas, and Texas punctuated the division's emergency management responses for the period.

From its beginning in 1937 through the mid-1990s, SWD provided a variety of services to eight States. The division's area of operations stretched from the Texas Gulf Coast to the Rocky Mountains, comprising over 16 percent of the nation's land area and encompassing 10 percent of the populace. SWD employs approximately 4,200 civilians and 35 military personnel, all of whom are engaged in water resources development, support to the armed forces, environmental regulation, environmental cleanup and restoration, and emergency services.

The division's civil works program includes management of 97 Corps lakes, on whose shores are located 660 Corps-managed recreation areas that receive 23 percent of all Corps visitors. The division manages the infrastructure for more than 20 percent of U.S. waterborne commerce on several of the nation's principal inland waterways and deep-draft shipping channels. Moreover, the division operates 18 hydropower projects and dozens of flood control projects throughout the Southwest.

SWD supports 36 Army and Air Force installations, and manages one-third of the Army's real estate holdings. The division supports other branches of the armed services and other government agencies through several support programs. It also provides emergency management, performs environmental cleanup and restoration, and oversees the Corps regulatory permit program implemented in the districts.

While division personnel oversaw the activities of the Fort Worth, Tulsa, Little Rock, Galveston, and Albuquerque Districts, significant changes were taking place nationally for the Corps. Military construction, which had increased dramatically during the late 1980s, precipitously declined in the early 1990s with the dissolution of the Soviet Union and consequent downsizing of the United States armed forces. In 1986, the U.S. Congress enacted the Water Resources Development Act, the first significant change to water resources policy in 16 years. This act affected the Corps' civil works activities in several ways, the most visible of which was to require increased participation by non-federal participation in funding water resources projects. Also, efforts to reorganize the Corps and, during the Clinton administration, "reinvent" government resulted in redirection for all Corps field operating agencies. During this period, SWD operated amid continuing uncertainty over reorganization and personnel reductions. Through all of these changes, SWD personnel attempted to clarify the division's role in the Corps' military construction, civil works, and other activities.

The 50 years following SWD's establishment have indeed been eventful ones for the division, the Corps, and the American people. In his official history, *The Southwestern Division: Fifty Years of Service* (1987), D. Clayton Brown ably chronicled the Corps' role in the southwestern United States. In our first chapter, we summarize the division's initial 50 years from a contemporary perspective. In subsequent chapters, we analyze SWD's role in managing the civil and military construction activities of its five districts during this crucial period in the Corps' history.

Many people have assisted us in writing this account of SWD from 1986 until 1994. We wish to acknowledge Col. James Paul King, Division Engineer through most of the project, and his Chief of Staff, Lt. Col. Robert

D. Besancon. Dr. Barry Rought, former Chief of Construction/Operations; Louis Carr, former Chief of Engineering; Paul Robinson, Director of Programs and Project Management; and Aldo Brazzale of the Military Programs Branch provided helpful insight into the history. William Baldwin and Martin Reuss of the headquarters of the U.S. Army Corps of Engineers, Office of History, gave needed perspective through chapter commentaries. Finally, we wish to acknowledge the division's Public Affairs Office, including its Chief, Lu Christie, and Rhonda James, Sally Anderson, and Anne Cannon for providing timely information, a quality work environment, and valuable assistance during preparation of the history.



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Peter Neushul is the author of articles in *Technology and Culture, Mid-America, Louisiana History,* and *The Journal for the History of Medicine and Allied Sciences.* He is completing a manuscript entitled The Arsenal of Democracy: Science and Technology on the Home Front. He holds a Ph.D. in history from the University of California, Santa Barbara, and is currently a visiting researcher at the California Institute of Technology, Pasadena, California.

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Chapter One:

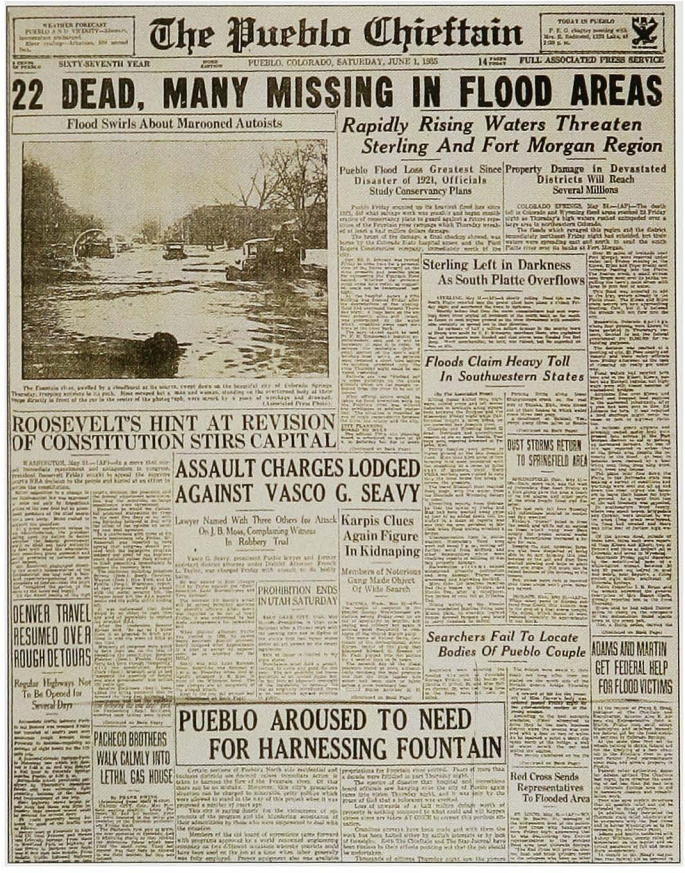
The First 50 Years of the Southwestern Division

The U.S. Army Corps of Engineers established the Southwestern Division (SWD) in 1937. At that time the Corps was designing and building some of the nation's largest water resources projects in an expansive civil works program. Historically, the agency had conducted military and civil engineering activities nationwide since its establishment in the late 18th century. Yet its most significant growth occurred during the early 20th century when a rapidly urbanizing nation required expanded federal water resources development to meet the needs of industry, agriculture, and burgeoning cities.

As a federal agency entrusted primarily with preserving and expanding the nation's navigational waterways, the Corps gradually began to expand its planning for flood control. With each major flood of the early 20th century, Congress responded with increased federal activity. The Flood Control Act of 1917, the first federal flood control legislation, authorized the Corps to build levees and remove debris from the Mississippi and Sacramento rivers.[1]

In 1925 Congress turned its attention to multipurpose water development directing the Corps, in conjunction with the Federal Power Commission, to submit a list of navigable streams that also had hydropower potential. In early 1927, concurrent with widespread flooding on the lower Mississippi River, Congress authorized surveys of these streams. In response, the Corps produced the "308 Reports," the agency's first comprehensive, multipurpose planning documents for water resources development.[2]

With each new decade of the 20th century, the issue of water resources development became more complex. During the Great Depression and New Deal, major public works projects became part of an overall plan to put Americans back to work and inject capital into the economy. The large-scale multipurpose dam and river improvement projects envisioned in the 308 Reports appeared to be good for the ailing economy. When floods devastated parts of New England in 1935 and the Ohio River Valley in 1936, President Franklin Roosevelt declared such disasters a menace to the economic recovery. Congress agreed, subsequently authorizing the Corps to supplement the 308 Reports and passing the Flood Control Act of 1936. Among many other elements, the 1936 act acknowledged flood control as "a proper activity of the Federal Government in cooperation with States, their political subdivisions, and localities thereof."[3] The act called for three structural solutions to flood control: levees and dikes, channel modifications or improvements, and dams and reservoirs.[4] The 1936 legislation essentially made the Corps the nation's primary federal flood control agency.[5]



The Pueblo Chieftain

SIXTY-SEVENTH YEAR — PUEBLO, COLORADO, SATURDAY, JUNE 1, 1935 — FULL ASSOCIATED PRESS SERVICE

22 DEAD, MANY MISSING IN FLOOD AREAS

Flood Swirls About Marooned Autoists

Rapidly Rising Waters Threaten Sterling And Fort Morgan Region

Pueblo Flood Loss Greatest Since Disaster of 1921, Officials Study Conservancy Plans

Property Damage in Devastated Districts Will Reach Several Millions

Sterling Left in Darkness As South Platte Overflows

Floods Claim Heavy Toll In Southwestern States

ROOSEVELT'S HINT AT REVISION OF CONSTITUTION STIRS CAPITAL

ASSAULT CHARGES LODGED AGAINST VASCO G. SEAVY

Lawyer Named With Three Others for Attack On J. B. Moss, Complaining Witness In Robbery Trial

Karpis Clues Again Figure In Kidnaping

Members of Notorious Gang Made Object Of Wide Search

PROHIBITION ENDS IN UTAH SATURDAY

DUST STORMS RETURN TO SPRINGFIELD AREA

DENVER TRAVEL RESUMED OVER ROUGH DETOURS

Regular Highways Not To Be Opened for Several Days

Searchers Fail To Locate Bodies Of Pueblo Couple

ADAMS AND MARTIN GET FEDERAL HELP FOR FLOOD VICTIMS

PACHECO BROTHERS WALK CALMLY INTO LETHAL GAS HOUSE

PUEBLO AROUSED TO NEED FOR HARNESSING FOUNTAIN

Red Cross Sends Representatives To Flooded Area

Floods such as this 1935 event along a tributary of the Arkansas River in and around Pueblo, Colorado, prompted federal legislation greatly expanding the U.S. Army Corps of Engineers' flood control activities. The Corps established the Southwestern Division in 1937.

Establishment of the Southwestern Division

The large-scale projects authorized by the Flood Control Act of 1936 and New Deal public works spending legislation led to the establishment of the Southwestern Division in 1937. Since the 19th century, several Corps district offices had carried out federal water resources development activities for the States of Texas, Oklahoma, Arkansas, and New Mexico. In New Mexico, the Conchas (later Albuquerque) District was building Conchas Dam on the South Canadian River with funds appropriated in the 1935

Emergency Relief Appropriations Act.[6] Along the Texas coast and inland, the Galveston District surveyed, dredged, built, and maintained Galveston Harbor.[7] In Arkansas and Oklahoma, the Corps directed operations through the Lower Mississippi Valley Division's Memphis District.[8] The sweeping Flood Control Act of 1936 greatly accelerated federal work. The act authorized 211 flood control projects nationwide. In the Arkansas River drainage alone, it authorized six major projects.

To carry out the expanded program in the Southwest, the Corps' Chief of Engineers created the Southwestern Division based in Little Rock, Arkansas, to manage operations in the Arkansas, Red, and White river valleys, and assigned Colonel Eugene Reybold, formerly of the Memphis District and later Chief of Engineers, to lead the new division. (Corps divisions, dating back to the 1880s, supervised local offices, provided technical review, allocated resources, and served as liaisons between district offices and headquarters.)[9] At the same time, the Office of the Chief of Engineers established Little Rock District. SWD now supervised the Little Rock and Conchas Districts. The division continued to expand during the 1930s, as new dam projects led to creation of two new districts: Denison District, established 1 January 1939, and Tulsa District, established 1 July 1939.[10]

World War II

During the 1940s, SWD expanded to include its present area of operations. Part of this growth was the result of the nation's preparation for and entry into World War II. The war greatly expanded the Corps' military mission. In late 1940 and early 1941, the Army's Quartermaster Corps transferred 83 Air Corps construction projects to the Corps. In response, the Corps moved SWD headquarters from Little Rock to Dallas, Texas, on 1 February 1941 because the fast-growing city in north central Texas was not only more centrally located than Little Rock but also an air, highway, and rail terminus.

In December 1941, Congress turned over all domestic military construction functions to the Corps. These duties had an enormous impact on SWD.[11] Corps divisions and districts reorganized to meet the needs of Army Air Corps bases. The Galveston and San Antonio Districts, which began operation on 16 December 1941, joined the other districts under SWD jurisdiction. The San Antonio District encompassed 90,000 square miles in 77 Texas counties. This shifted the balance of division operations to the south and west of Little Rock. For the duration of World War II, the division supervised six districts: Albuquerque, Denison, Galveston, Little Rock, Tulsa, and San Antonio.

With the addition of domestic military construction to its civil works mission, the Corps grew rapidly. SWD supervised the construction of Army and Army Air Corps bases, arsenals, factories, and numerous other projects across the Southwest. According to the *Dallas Times Herald*, the Albuquerque District alone built "twenty-three airfields, two ordnance depots, five installations for Army ground forces, three prisoner of war camps, one Japanese relocation center, two general hospitals, and three civilian war housing projects."[12] The division's procurement branch supported military construction by purchasing equipment ranging from hand tools to bulldozers.

Located in the heart of the "oil patch," the division became actively involved in procuring fuel-related technologies, including small gasoline power pumps, portable fuel lines, aviation fuel storage tanks, and paving materials. Portable fuel lines were crucial to the Allied north African campaign; their deployment played a pivotal role in the eventual defeat of German Field Marshal Erwin Rommel. Use of the camouflaged lines eliminated the need for easily targeted fuel trucks. The division's portable pumps replaced the trucks with a reliable and easily replaceable substitute. The division awarded $100 million in contracts for fuel pump manufacture, approximately 75 percent of all pipeline pumps used during World War II.[13]

SWD's wartime procurement also included real estate transactions. The division purchased the 54,000-acre Los Alamos School Ranch, and began construction of laboratory and housing facilities for the scientists and engineers who designed the first atomic bombs. Beginning in 1942, the division acquired land for 11 new Texas air bases at Matagorda, Eagle Pass, San Angelo, Lackland, Big Spring, Austin, Victoria, Galveston, Palacios, Bryan, and Brownsville. In Oklahoma, the division purchased land for air bases at Enid, Muskogee, and Oklahoma City.[14]

Defense plant construction was another of the division's major wartime activities. Division-built arsenals included the Oklahoma Ordnance Works at Chouteau, Oklahoma; the Pantex Plant at Amarillo, Texas; the Red River and Lone Star plants at Texarkana, Texas; and the Longhorn Plant at Marshall, Texas. During the war, the division supervised construction of seven of the 50 largest domestic military command facilities, including Fort Hood, Kelly Field, Red River Ordnance Depot, and Fort Bowie in Texas; Fort Gruber and Tinker Army Airfield in Oklahoma; and Fort Chaffee in Arkansas. Fort Hood required an expenditure of more than $79 million, second only to the cost of building the Pentagon.[15] At the conclusion of the war, SWD's staff had increased to 700, with responsibility for one-fifth of the Corps' total construction budget.[16]

Post-war Civil Works

With the war effort in full swing, Corps of Engineers civil works expenditures declined precipitously. Agencywide funding for flood control and river and harbor development dropped from approximately $200 million in 1941 to less than $100 million in 1945.[17] World War II brought a halt to civil works at all SWD sites except Denison, on the Texas-Oklahoma border, and Norfork, in Arkansas. These projects continued during wartime only because the dams had hydroelectric power potential for use at nearby defense plants. Domestic needs for water resources development continued despite the war. In 1943, for example, spring rains in the Arkansas River basin caused large-scale flooding along streams in Oklahoma and Arkansas. The river reached historic levels at Muskogee, Oklahoma, and Fort Smith, Arkansas, requiring massive sandbagging efforts to protect structures.[18] The flood underscored the need for additional flood protection.

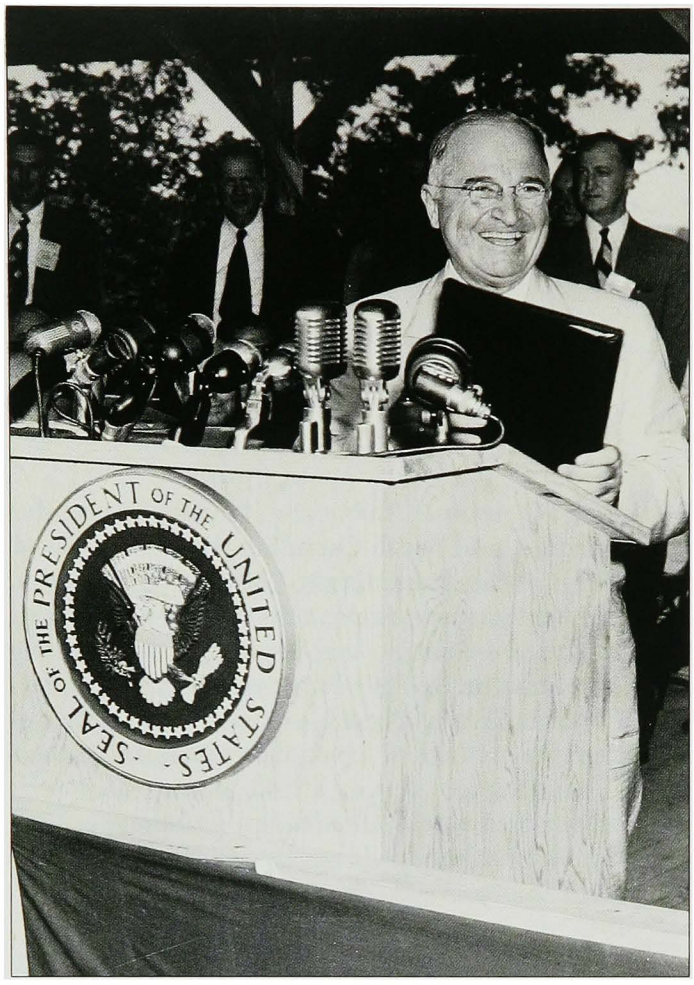
Flood Control Projects

As military construction declined with Allied Forces' victory at hand, SWD resumed many civil works. Among the first were dam and levee projects on the Arkansas, White, Black, North Canadian, and South Canadian rivers. The Flood Control Act of 1936 had authorized six flood reservoirs on the Arkansas River, located at Caddoa, Optima, Fort Supply, Great Salt Plains, Hulah, and Conchas. In 1937, the Corps initiated planning for seven more dams in the division: Manford, Oologah, Tenkiller Ferry, Wister, Blue Mountain, and Nimrod.[19] Before the war, the division had begun construction on Clearwater Dam on the Black River (Missouri), and on Nimrod Dam on the Fourche La Fave River and Blue Mountain Dam on the Petit Jean River (both in Arkansas). Work also continued on Conchas Dam in New Mexico. In 1939, with the addition of the new Denison and Tulsa districts, work began on Texoma Reservoir on the Red River at Denison, and on the Canton and Salt Plains reservoirs in Oklahoma.

In 1944, President Roosevelt directed the Corps to begin planning postwar civil works. In addition, Congress authorized many projects when it passed the Flood Control Act of 1944, legislation establishing civil works policies that would



Flooding along the Trinity River in 1942 was one of many such events that resulted in passage of the federal Flood Control Act of 1944, which expanded SWD's post-war civil works.



President Harry S. Truman dedicates Norfolk Dam (Little Rock District) shortly after the end of World War II.

guide the Corps through the coming decades.[20] Between 1944 and 1950, in an overall program of river basin development, SWD built 23 reservoirs.

To streamline the civil works program, in April 1945, the Corps incorporated the Denison District into the Tulsa District. The agency also transferred responsibility for the upper Trinity River basin to the Galveston District, and responsibility for the Red River above Fulton, Arkansas, to the Tulsa District.[21] In March 1950, SWD expanded further with the establishment of the Fort Worth District, which assumed civil works duties in northern Texas previously handled by the Galveston District.[22]

On the national level, the Federal Interagency River Basin Committee coordinated river basin plans. On the regional level, SWD chaired a special study of the Arkansas, White, and Red River Basins (AWRBIAC) with the Departments of Commerce and Interior, the Federal Power Commission, and the Public Health Service.[23] In 1955, AWRBIAC produced a 25-year "physical" plan that explored possible agency projects. The projects included a variety of flood control, hydropower, and navigation works.[24]

McClellan-Kerr Navigation System

The largest and most comprehensive civil works project of the division's first 50 years was the 448-mile McClellan-Kerr Arkansas River Navigation System. Residents of Arkansas and eastern Oklahoma had long used the river for inland navigation. During the cotton boom of the early 1900s, farmers shipped their products via paddle wheelers from the inland prairies of Oklahoma to New Orleans markets. The discovery of oil in Oklahoma around 1910 brought rapid growth to the state and its second-largest city, Tulsa, on the Arkansas River. Dreams of a dependable, year-round waterway to ship petroleum and agricultural goods persisted through the Great Depression and World War II.

As the concept of multiple-purpose water development evolved in the early 20th century, support for building projects that provided navigation, flood control, and hydroelectric power gained momentum. Public pressure and the flooding of the Mississippi Valley in 1927 led Congress to direct the Corps of Engineers to survey the Arkansas River basin for multiple-purpose development. In July 1935, the Memphis District presented a comprehensive, three-volume study published as part of House Document 308.[25] The Corps estimated construction costs for a waterway extending up the Arkansas River to Tulsa, Oklahoma, at $192 million, with an annual operating cost of $18.7 million. However, the Corps projected an annual savings in freight of only $10.2 million. As a result, the Corps rejected the idea of constructing a waterway, although it did endorse some flood control measures. The Corps' findings disappointed project advocates, who vowed to seek evidence contradicting the 308 report.[26]

The Flood Control Acts of 1937 and 1938 allocated funds for 13 flood control dams in the Arkansas basin. However, the acts did not authorize construction of navigation facilities. The major obstacle to developing a waterway was the prohibitive cost of solving two major problems: lack of sufficient water to support barge traffic, and a history of severe flooding on the river. In 1939, Col. Eugene Reybold, the first commander of SWD, formed an Arkansas River Survey Board consisting of Corps military and civilian personnel to reassess the proposed navigation project. In 1945, the Survey Board produced a report estimating that a navigable waterway extending up the Arkansas River to Muskogee, Oklahoma, and then up the narrower Verdigris River to Catoosa, near Tulsa, could be built for $523 million. The proposed project had a benefit-cost ratio of slightly greater than one.[27]

The Survey Board's report, however, expressed serious concerns about sediment buildup in the proposed waterway. The wide sandbars along the Arkansas River and its tributaries could cause levels of siltation that might greatly increase maintenance costs. Based on these concerns, the Survey Board recommended that navigation plans be delayed until the Corps had conducted extensive siltation studies and obtained better estimates of hydropower demand.

Despite the Corps' evaluation, Congress included the Arkansas River navigation project in the 1946 Rivers and

Harbors Bill. Supporters took advantage of public concern that the economy might slip into its pre-war condition if government public works expenditures declined. In 1946, Congress approved the bill and President Truman signed it into law. The Arkansas River project now joined 900 others whose construction had not yet begun. When Congress directed the Corps to prioritize its projects, the Corps responded by dividing its authorized projects into three categories: active, inactive, and deferred pending further study. The Arkansas River project fell into the third category, largely because of its poor cost-benefit ratio and silting concerns.

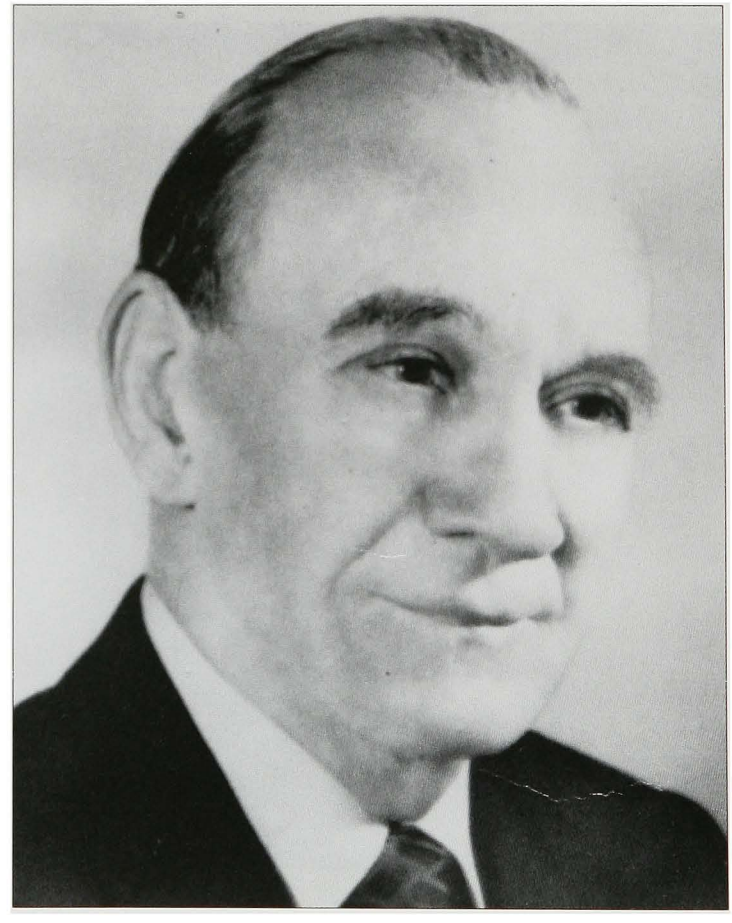
As the Corps evaluated the nation's navigation system, two major proponents of the Arkansas project were elected to public office. John L. McClellan, a former Arkansas representative, was elected to the United States Senate, where he introduced legislation providing for navigation improvements in the Arkansas and White river basins. In 1942, Robert S. Kerr, co-founder of the Kerr-McGee Oil Company, was elected Governor of Oklahoma. Six years later, Kerr joined McClellan in the Senate. Both men actively pursued approval for the Arkansas River waterway.

Meanwhile, the Corps of Engineers modified its plan to deal with the silting problem. After reexamining the potential economic impact of the waterway, SWD revised the benefit-cost ratio to 1.20:1.00. Silting, however, remained a major barrier to the navigation project. To prevent an estimated 120 million tons of sediment per year from clogging the new waterway, engineers believed that at least two "silt trap" reservoirs would be necessary. The two essential dams were Eufaula on the South Canadian River, and Keystone, where the Cimarron River joined the Arkansas River.[28] Four additional silt-trap dams might also be required lower on the system. In 1956, however, the Bureau of the Budget omitted funds for both reservoirs, as well as for Dardanelle Lock and Dam in Arkansas. In response, the Office of the Chief of Engineers withdrew its support for the entire project.

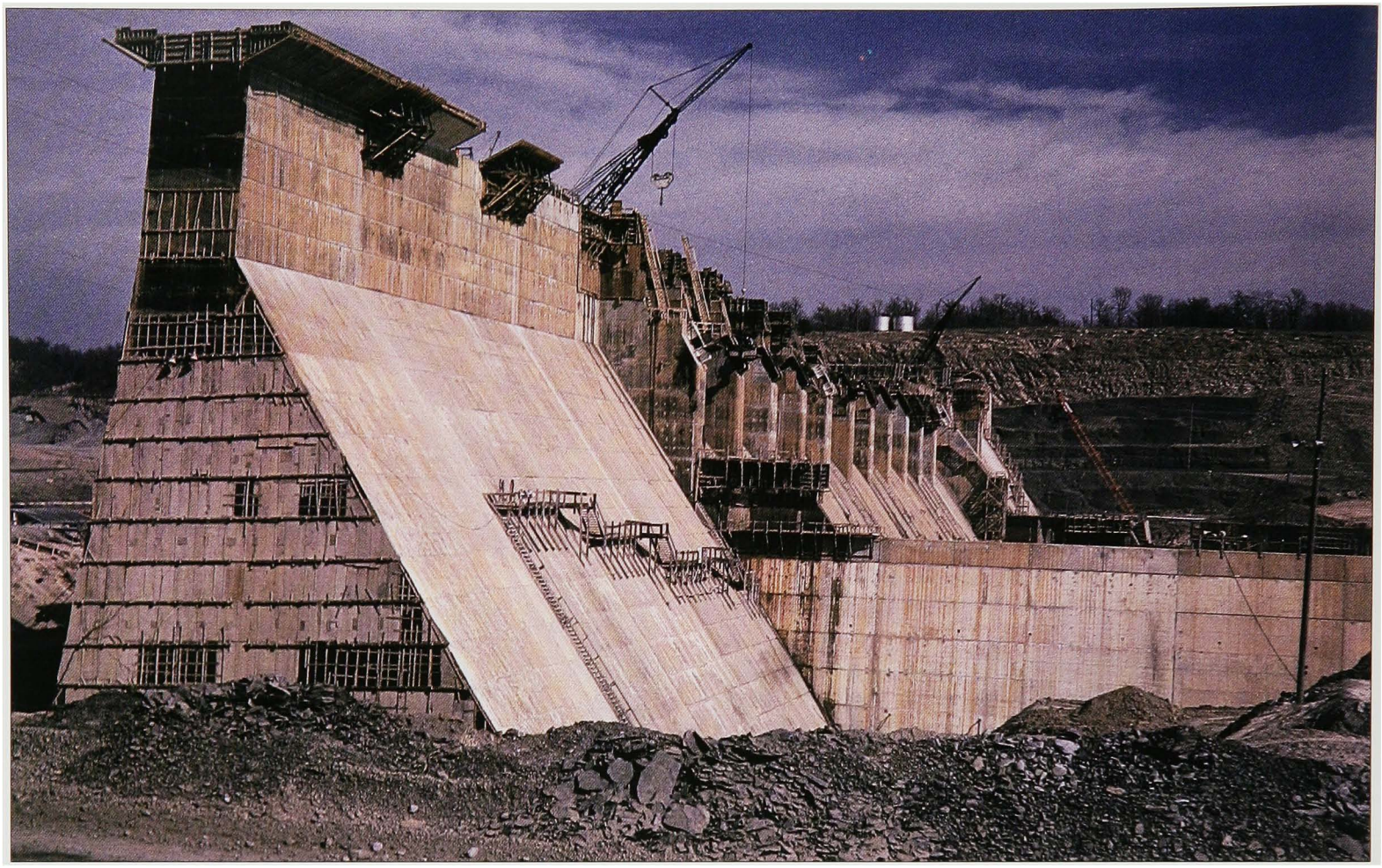
With the navigation system issue again at an impasse, proponents responded quickly to the Bureau's decision. Senator Kerr had become chairman of the Senate Public Works Committee, which had authority over construction of the Interstate Highway System and other large projects. In exchange for his support for the $27.5-billion Highway Act, Kerr's colleagues guaranteed the $2.4 million needed to start construction of the Keystone, Eufaula, and Dardanelle projects. All these projects were on the Corps' inactive list, yet the senator's influence ensured their congressional funding. In 1957, construction began on all three dams.[29]

The Corps, from the Chief of Engineers to the Board of Engineers for Rivers and Harbors, continued to have reservations about the Arkansas River waterway. Lieutenant General Emerson C. Itschner, Chief of Engineers, believed that the silt issue was never properly addressed.[30] In 1958, he appointed Brigadier General William Whipple, Jr., as the new SWD engineer. Whipple, a silt specialist, had opposed the Arkansas River navigation system while serving in the Civil Works Directorate of headquarters. It became Whipple's job to work

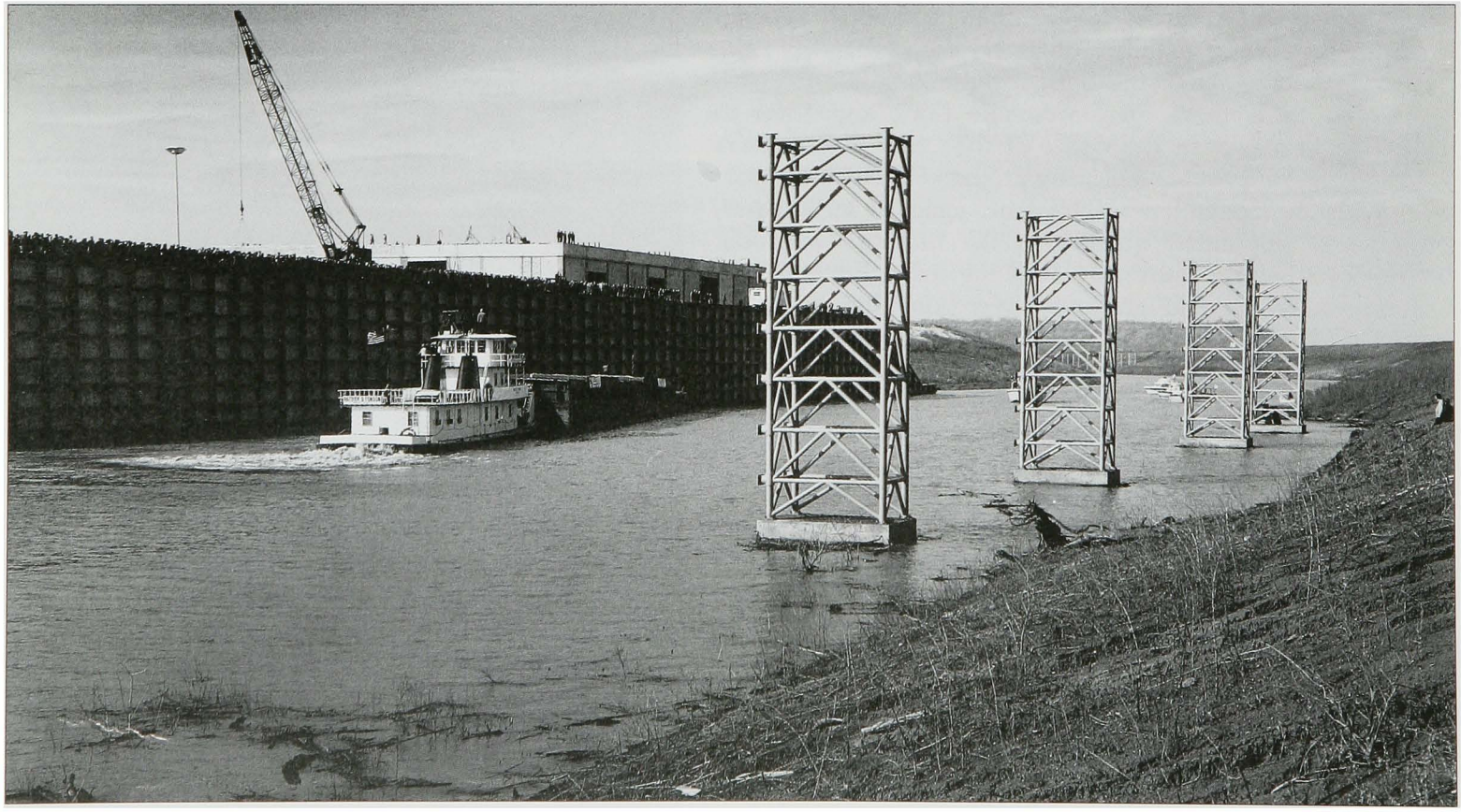




Robert S. Kerr of Oklahoma (above) and John L. McClellan of Arkansas were instrumental forces in developing the waterway through their states.



Construction was under way at Eufaula Dam on the South Canadian River in eastern Oklahoma (1962).



The first commercial barge leaves Tulsa's Port of Catoosa (January 1971).



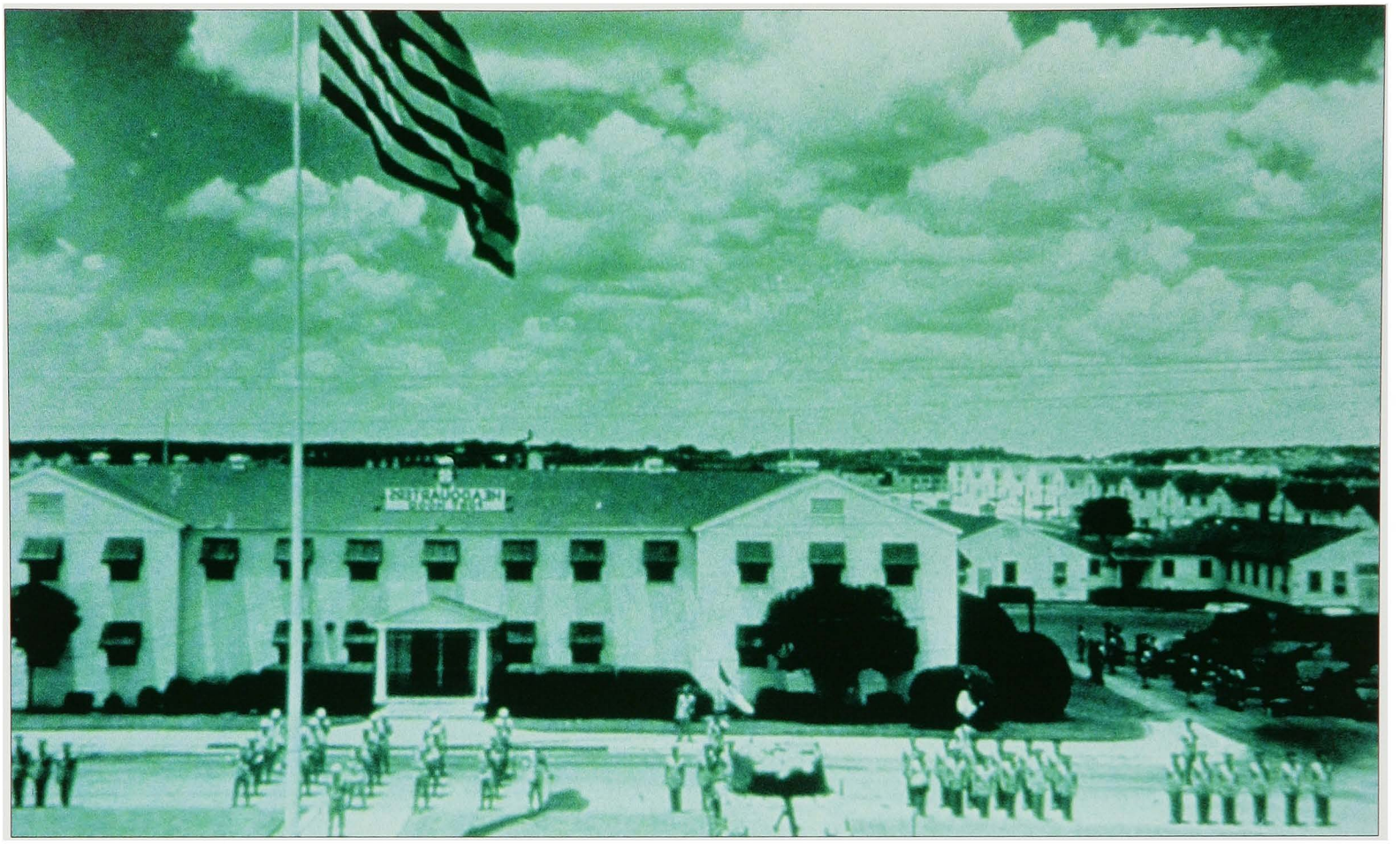
Lock and Dam 13 located east of Fort Smith, Arkansas (Arkansas River, 1970).

out the engineering details that would minimize sedimentation.[31] After reassuring the Tulsa Chamber of Commerce that there would be no further discussion or delay of the navigation project, Whipple formed an Arkansas River Sediment Board to determine whether the planned reservoirs above the project would trap enough silt. Whipple's goal was to eliminate three or four of the proposed dams in the lower segment of the project. He enlisted the services of the Corps' Waterways Experiment Station (WES) at Vicksburg, Mississippi. Models produced at WES demonstrated that deepening the navigation pools, and narrowing the proposed channel and confining it to a prescribed route would increase velocity and cause the river to cleanse itself. Using this technique, the Corps eliminated three proposed dams at a savings of $31 million.

With these engineering solutions, the Corps overcame the final obstacles. Proponents of the waterway had finally prevailed. Construction of the $1.2-billion McClellan-Kerr Arkansas River Navigation System–named after its two champions(continued through the 1950s and 1960s. The dedication of the system took place on 6 June 1971; shortly thereafter the first barge completed its journey through the 17 locks and dams of the new waterway to Tulsa's Port of Catoosa.[32]

Transitions in Military Construction: World War II through Vietnam

The Allied victory in World War II brought an abrupt end to the intense mobilization that had dominated the nation since 1941. The Department of Defense carefully reviewed all of its national construction projects, choosing those that would best serve its needs, eliminating some planned work, and terminating work far from completion.[33] Because of its shrinking military construction program, SWD's military branch became part of the Construction/Operations Division, and its personnel began focusing on the review of civil works projects. In 1947, SWD and its districts participated in the design of eight veterans' hospitals within the area of operations. Military construction continued, but on a much smaller scale than in the war years.



The Southwestern Division oversaw construction of expanding Army and Air Force facilities after World War II, including a significant enlargement of Fort Hood (Texas).

Following the war, the U.S. Air Force became independent from the Army. Because the Air Force had no engineering or construction organization, Congress mandated that the Corps perform those functions for both the Air Force and the Army. Subsequently, over the next decade, SWD oversaw the upgrading of facilities at Kirtland and Manzano Air Force bases (both in New Mexico), and Carswell Air Force Base in Texas.[34]

During the late 1940s, tensions between the Soviet Union and the United States increased dramatically. By 1950, this tension flared into a military conflict on the Korean peninsula. As a consequence, military construction experienced a sudden resurgence nationwide. In the Tulsa District alone, expenditures went from $1 million in 1950 to $150 million by the end of 1953. Galveston District's military projects grew from $225 million during World War II to $350 million at the conclusion of the Korean War.[35]

Fort Hood, the largest Army post in both SWD and the nation, underwent significant changes because of the Korean war. In 1950, the Defense Department reactivated Fort Hood and designated it as a permanent facility.[36] To properly house incoming personnel, the division oversaw construction of 380 permanent officer and enlisted quarters, 200 family housing units, an elementary school, a water supply system, a post exchange, and a club for enlisted personnel. Fort Hood also grew by 54,000 acres to accommodate long-range tank training activities. Expansion continued throughout the 1960s. By 1975, Fort Hood employed a combined military and civilian population of 63,500.[37]

As the Cold War intensified and the threat of nuclear war grew, the Air Force's Strategic Air Command (SAC) became more important to the nation's security. The creation of SAC led to significant military construction throughout the Southwest, including air bases for B-52 bombers and KC-135 tankers. In 1953, the Fort Worth District began construction of Dyess Air Force Base at Abilene, Texas. Dyess was the division's largest single project during the early 1950s, and included construction of aircraft hangars, warehouses, barracks, educational and training facilities, and water treatment plants.[38]

Another major nuclear weapons program under development was the Air Force's Intercontinental Ballistic Missile (ICBM) system. The division's first experience with missile-related construction dated back to the end of World War II and the research and development program at White Sands Missile Range in New Mexico. As the Nazi regime collapsed in 1945, the government launched Operation Paperclip to bring German scientists to the West before they fell into Soviet hands. Wernher Von Braun, the premier German rocket builder, was among those taken from the German V-2 rocket program at Peenemunde, Germany, and relocated to White Sands. A number of Hitler's notorious V-2 "Vengeance" weapons

were also transported to White Sands. At White Sands, SWD built launching pads for the prototype ICBMs. This missile technology later powered NASA's Apollo program.[39]

By the late 1950s, the division had begun building missile facilities, including surface-to-air missile silos for protection of major urban areas. As missile technology expanded, the division also built facilities for the larger and more complex Atlas and Titan ICBMs armed with nuclear warheads. The Fort Worth, Tulsa, and Albuquerque districts built ICBM silos at Dyess, Altus, and Walker Air Force bases in support of the national program.[40]

The military expansion of the 1950s and early 1960s waned during the following decade. Even the escalation of hostilities in Vietnam did not reverse this decrease in military construction. In response, the Office of the Chief of Engineers removed military construction from all but 17 of its 39 districts. In SWD, Galveston, Tulsa, and Little Rock districts lost all military construction responsibilities, with Fort Worth District assuming military construction in the states of Arkansas, Oklahoma (except Altus Air Force Base and Fort Sill), Louisiana, and part of Texas. Albuquerque District shared military construction responsibilities for the remainder of Texas and all of New Mexico. By 1971, with Albuquerque District's military construction declining even further, Fort Worth District assumed control of all military construction in SWD.[41]

The Southwestern Division Laboratory

In both military and civil construction projects, the division's laboratory (SWDL) played an important role. SWDL began as a soil testing facility for construction of Denison Dam during the late 1930s. Such testing was a common practice at Corps dam sites where soil plasticity determined the placement of dam footings. In 1947, the Denison facility became one of six Corps laboratories to conduct new freeze-thaw tests of concrete aggregates. By 1949, the division moved SWDL to Dallas because the costs of operating a laboratory more than 75 miles from division headquarters proved too expensive. From its location in a converted warehouse on Cass Street, the laboratory undertook responsibility for all soil, concrete, and riprap testing in the division.

During the 1950s and 1960s, SWDL became influential in developing diamond drilling technologies for use in sampling dam foundations. It also assumed responsibility for procuring, salvaging, and standardizing industrial diamonds for the Corps and outside agencies. During the 1970s and 1980s, SWDL's responsibilities were increased to include water and soil testing for toxins and other hazardous materials. Using new instrumentation, laboratory personnel could detect concentrations of pollutants in parts per billion. Since its inception, SWDL has adjusted to meet the needs of the Corps and other customers, and has been a mainstay of SWD.[42]

Civil Works in a Growing Region

Although the McClellan-Kerr navigation project dominated the division's civil works activities in the 1950s and 1960s, many other water resources projects were under way at the same time. With their increasing populations, there was enormous growth in the economic activities of Texas, Oklahoma, Arkansas, New Mexico, southern Kansas, and southern Colorado during the post-World War II era. By 1970, Texas was the nation's third most populous state, and would soon surpass New York to become the second most populous. Arkansas, Oklahoma, and New Mexico all experienced substantial growth as well. Urbanizing populations settled into flood-prone areas; business and industry demanded modern waterways and harbors. SWD oversaw its five districts in construction of numerous dams, flood control works, bank stabilization, harbor and channel improvements, and shore protection projects for this fast-growing "Sunbelt" region of the United States.

At about the same time, federal water resources management underwent sweeping changes for several reasons. Public concerns about environmental quality became a central issue that had dramatic impact on Corps civil works projects. In the 1960s and 1970s, the view that large water projects damaged the environment gained momentum. Critics also began to question the wisdom of using federal tax dollars to finance water projects that arguably benefited only local or regional interests. Other critics desired to reduce the size of the federal government and targeted activities such as the Corps' civil works program.

Such new concerns significantly changed the Corps' civil works program. Construction of water projects became far more challenging as an onslaught of legislation followed the shift in public opinion. The most significant legislation was the National Environmental Protection Act (NEPA) of 1969. The NEPA stipulated that all federal development required preparation of an environmental impact statement (EIS). In the following year, the Flood Control Act of 1970 required federal water agencies to involve the public in planning projects and to include the objectives of regional economic development, environmental quality, social well-being, and national economic development. In 1973, the federal Water Resources Council issued the "Principles and Standards for Planning Water and Related Land Resources," reducing the required

objectives to two: national economic development and environmental quality. The Water Resources Development Act of 1974 raised the discount rate in calculating benefits and costs of proposed projects. The cumulative effect of these laws and guidelines was to complicate the process, slow the pace, and hinder justification of public works projects. Corps projects thereafter underwent unprecedented planning, public participation, economic scrutiny, and environmental review.[43]

The divisional role became even more crucial as new planning directives and guidelines came from headquarters. SWD responded in several ways. In 1965, it established an Economics and Social Analysis Branch to provide districts with centralized economic planning tools and technical analysis that did not exist at the district level.[44] The division also began a program in conjunction with the Corps' Institute for Water Resources to examine the ex post facto impact of the McClellan-Kerr navigation system. The continuing study provided the Corps with a better understanding of the social, environmental, and economic consequences of a large water resources project.[45] By the mid-1970s, the division was also conducting various water supply studies for its districts. These were only a few of the measures taken at the division level to meet the new planning challenges.[46]

While the Southwest region continued to expand economically and demand federal water resources development, new legislative, political, and financial constraints made construction even more difficult. Although each district completed projects during the 1970s and early 1980s, the level of construction activity plummeted. In constant dollars, the division's construction funding dropped from almost $127 million in 1974 to $52 million in 1985.[47] Since 1970, Congress had not passed a significant water resources funding act. During his term in office (1977-1981), President Jimmy Carter issued a "hit list" of federal water projects for elimination. In addition, financial constraints grew tighter as the federal deficit increased. In SWD, the planned Trinity River waterway, connecting Dallas to the Gulf of Mexico, fell victim to environmental and cost constraints as well as public opposition.[48] Likewise, the Tulsa District's plan to build Lukfata Reservoir on the Glover River in southeastern Oklahoma did not proceed to construction because of marginal benefit-cost, the unwillingness of the local sponsor to contribute sufficient funds, and environmental controversy.[49] Events from the mid-1960s through the mid-1980s suggested that the Corps' "big dam era" had come to an end.[50]

Other federal legislation of the 1970s actually added new missions for the Corps. Section 404 of the Federal Water Pollution Control Act (FWPCA) Amendments of 1972 required permits for the placement of any dredged or fill material in U.S. waters or adjacent wetlands. FWPCA's environmental component expanded Corps authority over the nation's waterways beyond the strictly navigational approach defined in the 1899 Rivers and Harbors Act. Also in 1972, Congress passed the Marine Protection, Research, and Sanctuaries Act to regulate ocean dumping of dredged materials. In 1973, the Endangered Species Act empowered the U.S. Fish and Wildlife Service to identify endangered and threatened flora and fauna. In 1977, FWPCA became even more powerful with the passage of the Clean Water Act.[51] At each level of the Corps, the new environmental and planning mandates challenged its personnel to meet public demands while continuing to provide water resources development to the nation.

The Reagan Defense Program

During the 1980s, military construction regained high priority with the Corps. President Ronald Reagan entered office in 1981 with an agenda of augmenting defense spending to improve the readiness of the armed forces. Reagan's military buildup generated a number of significant projects for SWD, but all the work remained in the Fort Worth District as prescribed by the 1971 directive.

Believing this situation detrimental to efficient operation, Major General Hugh G. Robinson, division commander from 1980 to 1983, sought permission from headquarters to distribute military contracts more evenly among the districts.[52] Robinson's main concern was that, with military construction gone from four of the five districts, the recent decline in civil works activities would compromise overall engineering exper-



The Sante Fe Building in downtown Dallas, home to SWD since 1941.

tise. By redistributing military work, Robinson hoped to maintain a broad base of engineering capability throughout the division. As a result, in 1981 Tulsa District resumed military construction activities in Oklahoma and Arkansas. Robinson later "directed Tulsa and Fort Worth Districts to 'broker' some of their military engineering and design work to other districts."[53] By 1985, Little Rock District resumed military construction activities in Arkansas. The next year, Albuquerque District resumed military construction activities in New Mexico.[54] As the decade proceeded, the division became increasingly involved in a wide range of military support activities, including hospital and installation construction, environmental restoration, real estate transactions, and support for other federal agencies.

The Division in the Mid-1980s

SWD strove to meet new challenges as military construction was revived in four of its five districts, civil works planning and construction underwent sweeping change, and regulatory and other management functions increased. Since its beginning in the 1930s, the division's overriding concern had been to provide the most effective management and review to the districts, while also properly interpreting Corps directives. In the rapidly changing 1980s, those tasks became increasingly complex and would continue to diversify in coming years.

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[1] Jamie W. Moore and Dorothy P. Moore, *The Army Corps of Engineers and the Evolution of Federal Flood Plain Management Policy* (Boulder, CO: University of Colorado Institute of Behavioral Science), p. 4; Jeffrey K. Stine, "Environmental Politics and Water Resources Development: The Case of the Army Corps of Engineers during the 1970s" (unpublished Ph.D. dissertation, University of California, Santa Barbara, 1984), p. 5.; D. Clayton Brown, *The Southwestern Division: 50 Years of Service* (Dallas, TX: U.S. Army Corps of Engineers, 1987), p. 2; Michael Welsh, *A Mission in the Desert: The Albuquerque District; 1935-1985* (Albuquerque, NM: University of New Mexico Press, 1987), pp. 19-22.

[2] Moore and Moore, *Evolution of Federal Flood Plain Management Policy*, pp. 4-6.

[3] Quoted in Martin Reuss, *Reshaping National Water Politics: The Passage of the Water Resources Development Act of 1986* (U.S. Army Engineer Institute for Water Resources Policy Study 91-1, 1991), p. 15.

[4] See Joseph L. Arnold, *The Evolution of the 1936 Flood Control Act* (Fort Belvoir, VA: U.S. Army Corps of Engineers Office of History, 1988), passim, for an analysis of this legislation.

[5] Moore and Moore, *Evolution of Federal Flood Plain Management Policy*, pp. 12-15; Beatrice Hort Holmes, *A History of Federal Water Resources Programs*, 1800-1960 (Washington, DC: U.S. Department of Agriculture, 1972) pp. 15-17.

[6] Welsh, *A Mission in the Desert*, p. 23.

[7] Bonnie B. Pendergrass and Lee F. Pendergrass, *In the Era of Limits: A Galveston District History Update, 1976-1986* (Washington, DC: U.S. Army Corps of Engineers, 1990), p. 10; Lynn M. Alperin, *Custodians of the Coast: History of the United States Army Engineers at Galveston* (Galveston, TX: Galveston District, U.S. Army Corps of Engineers, 1977), passim.

[8] Brown, *The Southwestern Division*, pp. 4-5.

[9] Ibid., p. iii.

[10] Ibid., pp. 4-7.

[11] See Barry W. Fowle, ed., *Builders and Fighters: U.S. Army Engineers in World War II* (Fort Belvoir, VA: U.S. Army Corps of Engineers Office of History, 1992), pp. 3-17 and 21-23, for an account of Corps organization and responsibilities with the coming of war.

[12] *Dallas Times Herald* (16 June 1943); also quoted in Brown, The Southwestern Division, p. 15.

[13] Brown, *The Southwestern Division*, pp. 15-17.

[14] Ibid., p. 19.

[15] R. Elberton Smith, *The Army and Economic Mobilization* (Washington, DC: Office of the Chief of Military History, Department of the Army, 1959), p. 449.

[16] Brown, *The Southwestern Division*, p. 23. The Division expended $2 billion during World War II.

[17] Fowle, ed., *Builders and Fighters*, p. 229.

[18] Brown, *The Southwestern Division*, pp. 22, 123.

[19] Ibid., pp. 22-23.

[20] See Fowle, ed., *Builders and Fighters*, Section IV, for a discussion of civil works during the 1940s.

[21] Brown, *The Southwestern Division*, p. 22.

[22] Ibid., p. 27.

[23] Holmes, *History of Federal Water Resources Program*, p. 18.

[24] Robert H. Pealy, *Comprehensive River Basin Planning: The Arkansas-White-Red Basins Inter-Agency Committee Experience* (Ann Arbor, MI: University of Michigan, 1959), pp. 54-56. Also cited in Holmes, *History of Federal Water Resources Program* (see note 5).

[25] Holmes, *History of Federal Water Resources Program*, p. 18.

[26] Brown, *The Southwestern Division*, pp. 95-109.

[27] William A. Settle, Jr., *The Dawning, A New Day For The Southwest: A History of The Tulsa District, Corps of Engineers, 1939-1971* (Tulsa, OK: U.S. Army Corps of Engineers, 1975), p. 47.

[28] Floyd M. Clay, *A History of the Little Rock District U.S. Army Corps of Engineers 1881-1979* (Washington, DC: U.S. Government Printing Office, 1979), p. 69; See also Mary Yeater Rathburn, *Castle on the Rock: The History of the Little Rock District, U.S. Army Corps of Engineers* (Little Rock, AR: U.S. Army Engineer District, 1990), Chapter V.

[29] For details on passage of the Federal Aid Highway Act, see Mark H. Rose, *Interstate: Highway Politics, 1941-1956* (Lawrence, KS: Kansas University Press, 1979).

[30] William Whipple, *"Unpublished Memoirs,"* pp. 347-348. These memoirs are now located at the Office of History, Office, Chief of Engineers, Fort Belvoir, VA. Also cited in Brown, *The Southwestern Division*, p. 102.

[31] Brown, *The Southwestern Division*, p. 102.

[32] Brown, *The Southwestern Division*, pp. 102-106; Warren J. Papin, *"Take 17 Giant Steps," Water Spectrum vol. 2, no. 3 (Fall 1970)*, pp. 6-14.

[33] *Southwestern Division, Southwestern Division U.S. Army Corps of Engineers, July 1, 1937-July 1, 1987: A Condensed History* (Dallas, TX: Public Affairs Office, 1987), p. 17.

[34] Brown, *The Southwestern Division*, pp. 71-73.

[35] Pendergrass and Pendergrass, *In the Era of Limits*, p. 13.

[36] Brown, *The Southwestern Division*, p. 73.

[37] Ibid.

[38] Ibid., p. 74.

[39] Gregory P. Kennedy, *Vengeance Weapon 2: The V-2 Guided Missile* (Washington, DC: National Air and Space Museum, Smithsonian Institution Press, 1983), p. 12; Linda Hunt, *Secret Agenda: The United States Government, Nazi Scientists, and Project Paperclip, 1945 to 1990* (New York: St. Martin's Press, 1991), p. 217.

[40] D. Clayton Brown, *Rivers, Rockets, and Readiness: Army Engineers in the Sunbelt* (Fort Worth, TX: U.S. Army Engineer District, 1979), pp. 51-52.

[41] Fort Worth's control over all military construction in the Southwestern Division took place following General Order No. 10, Headquarters, Department of the Army, Office of the Chief of Engineers, Washington, D.C., 19 April 1961 and General Order No. 23, Headquarters, Department of the Army, Office of the Chief of Engineers, Washington, D.C., 18 June 1970.

[42] Brown, *The Southwestern Division*, pp. 126-129.

[43] Moore and Moore, *Evolution of Federal Flood Plain Management Policy*, pp. 103-107; U.S. Army Corps of Engineers, *Digest of Water Resources Policies and Authorities*, EP 1165-2-1 (25 February 1989), 2-1-2-9.

[44] Brown, *The Southwestern Division*, pp. 135-137.

[45] See U.S. Army Engineer Institute for Water Resources, *A River, A Region, A Research Project* (IWR Research Report 72-1), for an example of the ex post facto studies of the McClellan-Kerr Project.

[46] Brown, *The Southwestern Division*, pp. 135-137.

[47] Ibid., p. 53.

[48] Ibid.; see Chapter 7 for a detailed discussion of the Trinity River waterway.

[49] See Lukfata Reservoir file, Public Affairs Office, Southwestern Division, Dallas, Texas; Interview, Gregory Graves, with Dr. Barry Rought, 16 Jan. 1995, Richardson, Texas.

[50] John Ferrell, *Big Dam Era: A History of the Pick-Sloan Plan* (Fort Belvoir, VA: U.S. Army Corps of Engineers Office of History, 1987), passim.

[51] Pendergrass and Pendergrass, *In the Era of Limits*, pp. 15-17.

[52] Ibid., p. 91.

[53] Ibid., p. 92.

[54] Ibid.

Chapter Two:

Supporting the Armed Forces

National defense and the support role of the U.S. Army Corps of Engineers underwent sweeping change during the 1980s and the early 1990s. Cold War tensions rose in 1980 with the Soviet Union's invasion of Afghanistan, and again in 1983 after the downing of a Korean Airlines passenger plane by a Soviet aircraft. Meanwhile, President Ronald Reagan, who came to office in 1981, believed that U.S. military capability had languished since the Vietnam War. He vowed to restore the strength of the armed forces. Consequently, annual defense expenditures increased steadily throughout the 1980s, peaking at $333 billion in 1989.[1] As each of the armed services underwent modernization and expansion, military construction organizations strove to meet the increasing workload. As construction agent for the U.S. Army and Air Force, the Corps had a host of new challenges during the 1980s.

In the late decade, sweeping geopolitical transitions took place that also had a dramatic impact on the armed forces and the Corps. New Soviet leaders sought better relations with the West, easing Cold War tensions and ushering in a new era of *glasnost* and *perestroika*. Meanwhile, internal strife weakened the rigid political structure of the Soviet Union and its satellite nations. One by one, the Soviet bloc countries went their own ways, declaring independence from the Union of Soviet Socialist Republics (USSR). On New Year's Eve 1991, the USSR, weakened by defection and disillusion, disbanded.

Although the western world celebrated the collapse of the USSR, the disappearance of a 48-year-old adversarial superpower had long-term implications. The formidable U.S. defense structure had been largely assembled to counter the post-World War II Soviet military threat. With that threat gone, some citizens and elected officials anticipated a "peace dividend" of reduced federal spending on national defense. The federal government responded with accelerated efforts to reduce or "downsize" the armed services-especially in numbers of people in uniform. At the same time, however, defense proponents were determined to maintain American military strength. Applied technology, always important to the armed services, became even more basic to meeting the dual objectives of having fewer people in uniform while simultaneously maintaining military capability.

The transitions of the 1980s and 1990s challenged the military construction mission of the Corps of Engineers. For Corps divisions with large military construction responsibilities, both the buildup and the downsizing initiated a variety of activities. With many military bases in its area of operations, SWD oversaw a variety of military construction activities during this period, such as strategic defense facilities, military housing and infrastructure, chemical weapons disposal, hospital construction, environmental restoration, and base realignment and closure.

Toward Partnering and Program Management

The many new challenges presented to Corps engineers were compounded by the federal budgetary crisis of the 1980s. The Corps needed to build infrastructure for the armed forces, but was challenged more than ever before to do so in the most cost-effective manner. The Corps responded in part by developing new methods of contract management. Lieutenant General Henry J. Hatch, Chief of Engineers from 1988 through 1992, formally introduced an approach called "partnering." "Partnering" attempted to defuse the potentially adversarial relationship that sometimes exists among contractors, the Corps, and users by fostering a cooperative spirit among all parties. The ultimate objective was the timely completion of high-quality projects. Division personnel introduced partnering early in the design process. At the beginning of a project, the parties involved participated in a workshop conducted by a professional facilitator to improve communications and cultivate teamwork. Partnering enabled Corps officials at the division level to ensure that time and cost commitments were met-and that progress on a given project proceeded smoothly.[2]

The concepts of program and project management began to gain momentum within the Corps during the late 1980s. First articulated by Robert W. Page, who became Assistant Secretary of the Army for Civil Works in December 1987, these concepts reflected Page's belief that the Corps needed to apply a private enterprise approach to its planning and construction. Project management (at the district level) and program management (at the division level) was a departure from the usual Corps contracting and construction procedures. Traditionally, districts managed the technical and monetary

aspects of projects during specific phases, such as design and construction. Now districts assumed management of an entire project from beginning to end, and divisions were given responsibility for oversight of entire military construction programs, such as Military Construction Army, Military Construction Air Force, Family Housing, and Non-appropriated Funds. Under the new system, division program managers did not involve themselves with day-to-day problems, but instead focused on resolving those problems that reached the customer's headquarters, emanated from Corps headquarters, or were identified by districts as requiring divisional attention. Division personnel served as liaisons for communications between Corps headquarters and the districts.[3] Each of these measures was designed to streamline the contracting process, complete projects on time and within budget, and satisfy Corps customers.

The New Armed Forces

One of the most important national defense initiatives of the late 1970s and 1980s was the conversion of the armed forces to all-volunteer status. The Vietnam War experience had demonstrated that conscripted individuals often proved to be unsatisfactory soldiers. To ensure a more effective fighting force, Department of Defense (DOD) officials developed long-range plans for an all-volunteer armed services. The Army Regimental System organized communities of battalions in which soldiers would spend their entire tours of duty. Other features of the New Manning System included higher salaries and reenlistment incentives. Increased pay was important, but equally significant was providing the new Army with better living quarters, and modern medical, shopping, and recreational facilities. To attract enlistees into the all-volunteer Army, the DOD sought to improve the quality of life for soldiers.

Brooke Army Medical Center

Building the infrastructure for the new Army gave the Corps added responsibilities and opportunities. Construction of Brooke Army Medical Center, a state-of-the-art facility at Fort Sam Houston in San Antonio, Texas, exemplified SWD's role in providing new facilities for the Army. A medical facility had existed at the site since 1870, when the U.S. Army built a small hospital for the Post of San Antonio. A log cabin had served as the hospital until 1886, when a permanent facility was constructed. As Fort Sam Houston grew, the need for additional hospital capacity increased. By 1937, the hospital had been enlarged to a capacity of 418 beds. At the beginning of World War II, the Army officially named the facility Brooke General Hospital in honor of former commander Major General Roger Brooke. During the war, the hospital grew to a capacity of over 1,500 beds housed in 45 structures. One building housed a world-famous 20-bed burn center.[4]

By the early 1970s, Brooke Hospital was showing signs of age. Thirteen units in several buildings were scattered across Fort Sam Houston, and most of the outmoded World War II-vintage facilities sorely needed modernization.[5] In 1973, Congressman Henry B. Gonzalez of Texas proposed a complete replacement for the medical center. The Corps was authorized to develop preliminary plans for a new medical center, but little else happened for the remainder of the decade.[6]

By the early 1980s, local Congressmen Abraham "Chick" Kazen and Tom Loeffler were campaigning for the finalization of general plans for the design of replacement facilities at Brooke Hospital. Meanwhile, Brooke slipped further into obsolescence. In 1984, Brigadier General Robert H. Buker, director of Brooke, called the hospital the "shabbiest" facility he had ever commanded. Sensing urgency, Loeffler and Kazen pressured members of the Military Construction Subcommittee of the House Armed Services Committee to add the medical center to the $10.5-billion military construction authorization bill for 1985.[7]

Controversy over Brooke arose at a subcommittee hearing chaired by Kazen. Pentagon and Army officials wanted a much larger medical center than some subcommittee members were willing to support. Testifying before the subcommittee, Major General Edward J. Huycke, the Deputy Surgeon General, noted that "Brooke is one of the most important of the eight existing U.S. Army medical centers," with a workload "second only to that of Walter Reed Army Medical Center here in the District of Columbia."[8] He also noted that, "during the third quarter of fiscal year 1983, Brooke had an average daily workload of 500 occupied beds, 54 daily admissions, 2.6 live births per day and some 3,000, almost 3,300 outpatient clinic visits per day."[9] After protracted debate, a compromise decision authorized a 450-bed facility-245 less than the original plans specified.[10] After years of planning, Brooke Army Medical Center (BAMC) was finally authorized.[11]

Following appropriation of funds, SWD began to participate in the difficult process of design and construction of BAMC. The division and its districts had had extensive recent experience with military medical facilities. Under the direction of division engineers Brigadier General James C. Donovan (1977-1980) and Major General Hugh G. Robinson (1980-1983), the division expanded medical facilities at Wilford Hall Medical Center in San Antonio. Division engineers Major General Robert J. Dacey (1983-1985) and Major General Jerome B. Hilmes (1985-1988) had overseen expansion of medical

facilities at Carswell Air Force Base in Fort Worth. The Corps also designed and built hospital expansion projects at Darnall Army Hospital at Fort Hood, Texas; Bayne-Jones Hospital at Fort Polk, Louisiana; and William Beaumont Hospital at Fort Bliss, Texas. These projects, all completed during the 1980s, gave the division and its districts valuable experience in hospital improvement, expansion, and construction.[12]

The original design for the BAMC called for a college campus-like arrangement. However, this design was eventually rejected because of the many connections required between buildings. Concurrent with the reduction in size of the medical center, the Corps redesigned the layout as one main hospital with two supporting buildings. In 1985, the architect-engineering firms HKS of Dallas and Wingler & Sharp of Wichita Falls began formal design of the medical center.

As designed, BAMC was to be built in three phases. Phase one, completed in 1987, was the construction of a road to the building site and site preparation; phase two, completed in 1992, included construction of an energy plant with a cooling tower and excavations; phase three, completed in 1997, involved construction of the main building and research facilities. The site of the hospital was within the boundaries of Fort Sam Houston, bordered on the east by Interstate 35 and on the south by Binz-Engelman Road.

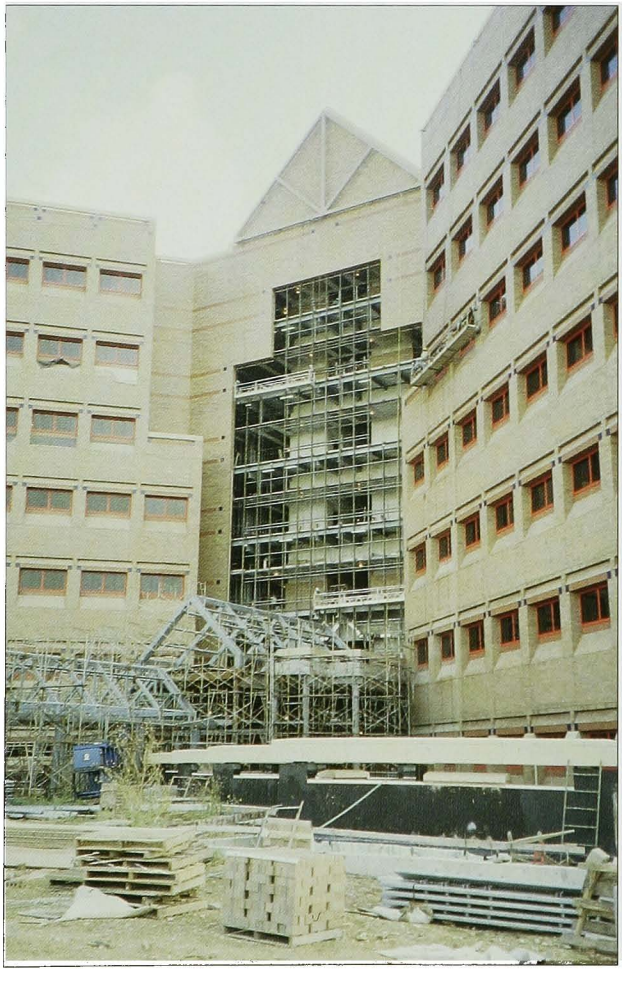
After years of planning, the medical center began to take shape. Some of the 45 buildings that comprised the old hospital disappeared as new facilities replaced them. BAMC consolidated all hospital functions into three main parts, including a seven-story, 1.5 million square-foot patient bed tower, a five-story ancillary services building with clinics and logistical support facilities, and a three-level medical mall. In all, there would be 5,200 rooms in the 450-bed medical center.

During the design and construction of the main facility, the division incorporated partnering by overseeing the continuous dialogue among Army hospital personnel, the Fort Worth District project office, and the contractors, George Hyman Construction and Manhattan Construction Company. As a result, construction of the hospital progressed substantially ahead of schedule. One example of how the partnering dialogue worked concerned flooring the main structure. Original hospital plans called for a dirt floor in the basement, a cost-cutting measure that left the excavated natural surface exposed. After meeting with all parties concerned, the division developed a plan for surfacing the floor with a concrete slab. The concrete floor not only facilitated construction of the project, but also served as useful space once the hospital



Construction progresses on Brooke Army Medical Center, October 1992; on following pages: October 1993, September 1994; the completed facility, 1997.





was completed.[13] Another partnering issue concerned adequate communications equipment. The division brought contractors and hospital officials together to discuss the best methods for installing telephone-switching gear, settling on a course of action that suited all parties. The division's efforts to promote quality assurance guaranteed that flexible telephone service would be installed throughout the medical complex.[14]

As the hospital construction proceeded, the divisional role remained crucial. Through close monitoring of funding for BAMC, division personnel quickly addressed problems that threatened to interrupt the flow of funds to the Fort Worth District for the massive project.[15] The division monitored the activities of liaison personnel from both the architectural-engineering firms and the Corps throughout the project. This partnering activity provided a forum for resolution of problems and quick approval of revisions during construction. Alan Rowe, BAMC Resident Engineer, estimated in 1994 that partnering had resulted in a tenfold decrease in written correspondence between the contractors and the government. Under the command of Col. James Paul King, who became Division Engineer in May 1993, SWD continued to refine partnering at Brooke. By the end of 1994, the project was more than 90 percent complete and ahead of schedule.[16]

SWD and its Fort Worth District did extensive evaluations of modern military hospital design as they worked on BAMC. The medical center followed a design called an integrated building system (IBS). On each floor, there is an 8.5-foot overhead space housing electrical, communications, ventilation, and plumbing lines. The overall facility includes 1 million square feet of IBS space and 1.5 million square feet of hospital space. The inclusion of IBS space helped the project move forward smoothly. With access to this space, service and maintenance per-



sonnel were able to complete installations and modifications with little interruption to the overall project. Other significant features of the medical center include a 280-seat auditorium and a 9,000-foot pneumatic tube delivery system. In the case of a military mobilization, the BAMC facility can be expanded from its normal 450-bed capacity to 653 beds.[17] BAMC was completed and turned over to the customer in March 1997.[18]

Military Housing

The changing composition of the U.S. armed forces establishment created demand for facilities. In particular, military housing needs changed with the conversion to an all-volunteer force. More mature soldiers, many of whom had families, would be housed on military bases. Secondly, women were joining the armed services in increasing numbers. Finally, to attract quality enlistees, the armed services had to provide quality on-base living conditions. New barracks, or older ones upgraded to meet new standards, were needed to house unaccompanied enlisted personnel. Bachelor's quarters, in some cases, could be upgraded to meet the Army's need for family housing units. The most common solution, however, was to build additional new family housing units at U.S. military installations both nationwide and worldwide. The Corps constructed thousands of units of family housing and support facilities for the Army and the Air Force during the 1980s and 1990s.

With a large defense presence throughout its area of operations, SWD participated significantly in providing military housing. In 1988, the Fort Worth District was awarded a $19.6 million contract to build a 350-unit family housing structure at Fort Polk. In 1985, the district began a three-phase project at Lackland Air Force Base to build unaccompanied enlisted personnel housing units (barracks). The new facilities, which replaced the 1950s-era dormitory-style barracks, featured private entrances, double-occupancy rooms, and bathrooms shared by only four people. The new units, three of which were completed between 1985 and 1993, provided energy-efficient, comfortable housing for almost 3,000 Lackland Air Force Base personnel. The Corps also completed a 1,500-person-capacity dining hall at a cost of $4 million. The Lackland facility took a new approach to food service by employing outside contractors to cook and serve meals.[19]

In 1990, SWD began a ten-year barracks rehabilitation and modernization project at Fort Hood, designed to bring 106 1950s-era buildings up to current standards. These 50,000-square-foot buildings contain sleeping and living quarters, laun-



Reynolds Hospital as it looked in 1994 (Fort Sill, Tulsa District).

dry facilities, equipment cleaning rooms, reading rooms, day rooms, and administrative, storage, and service areas.[20]

Other military housing support activities within SWD included the Tulsa District's work at Tinker Air Force Base and Fort Sill, one of the Army's largest training facilities. To accommodate new armed forces personnel associated with a "bed-down" of U.S. Navy communications aircraft, the Corps constructed residential, medical, and dining facilities at Tinker Air Force Base near Oklahoma City. At Fort Sill, near Lawton, Oklahoma, the Corps built five barracks complexes. Each complex housed 1,120 trainees, and included dormitories, mess halls, and supply facilities.[21] Fort Sill was also the site of a $52.2 million, 301,000-square foot hospital project, construction of which began in 1990.[22] At Holloman Air Force Base in New Mexico, the Albuquerque District constructed a dormitory complex to support military personnel involved with strategic aircraft bed-downs. They also managed family housing projects at Cannon Air Force Base totaling $33 million.[23]



F-117A fighter arrives at Holloman Air Force Base, New Mexico (Albuquerque District).



A Stealth Fighter is sheltered in a hangar constructed by the Corps of Engineers (Holloman Air Force Base).

Support to the Air Force: Strategic Aircraft Facilities

In addition to developing all-volunteer armed services, the DOD stepped up efforts to incorporate more applied technology. The post-Vietnam armed services relied on advanced technologies as a mainstay of the new military. Moreover, during the Reagan presidency, there was renewed resolve to find technological solutions to the deadlock of mutually assured destruction from thermonuclear war. New policies included the development of strategic weapons systems and support facilities for these advanced technologies. These systems highlighted a comprehensive effort to apply modern technology to all aspects of national defense.

SWD area of operations includes some of the nation's most important Air Force bases, housing some of the world's most sophisticated military aircraft. Holloman Air Force Base in New Mexico, for example, became the base for the Stealth fighter, the F-117A fighter designed by Lockheed Corporation to be undetectable by enemy radar. By 1983, the F-117A was fully operational and performed well during the 1991 Persian Gulf War.[24]

Creating a bed-down and maintenance facility for the F-117A presented new problems for military engineers. The Air Force wanted to transfer its fleet of Stealth fighters from the Tonopah Test Range in Nevada to Holloman Air Force Base in New Mexico, and called on the Albuquerque District to provide facilities for the top-secret aircraft. To accommodate a fleet of Stealth fighters, the district built extensive support facilities at Holloman. Because of its delicate exterior, each multimillion-dollar Stealth aircraft had to be sheltered. The Stealth bed-down required ten 35,000-square-foot, four-bay hangars constructed of solid stainless steel at a cost of $63 million each. The hangars had their own refueling systems and were capable of fueling several planes at once. Because the planes were refueled inside the hangers, sophisticated vapor detection and extraction systems were designed for and installed in each hangar. In addition, the hangars required heating, ventilation and air conditioning systems, new electrical substations, and approximately 40,000 square yards of additional concrete. The new bed-down required a 27,000-square-foot operations room, including a storage facility and space for an F-117A flight simulator. In all, the project required 2.5 miles of stainless steel pipe, 655,000 square feet of metal sid-



Inside the hangar a U.S. Navy E6A is serviced (Tinker Air Force Base).

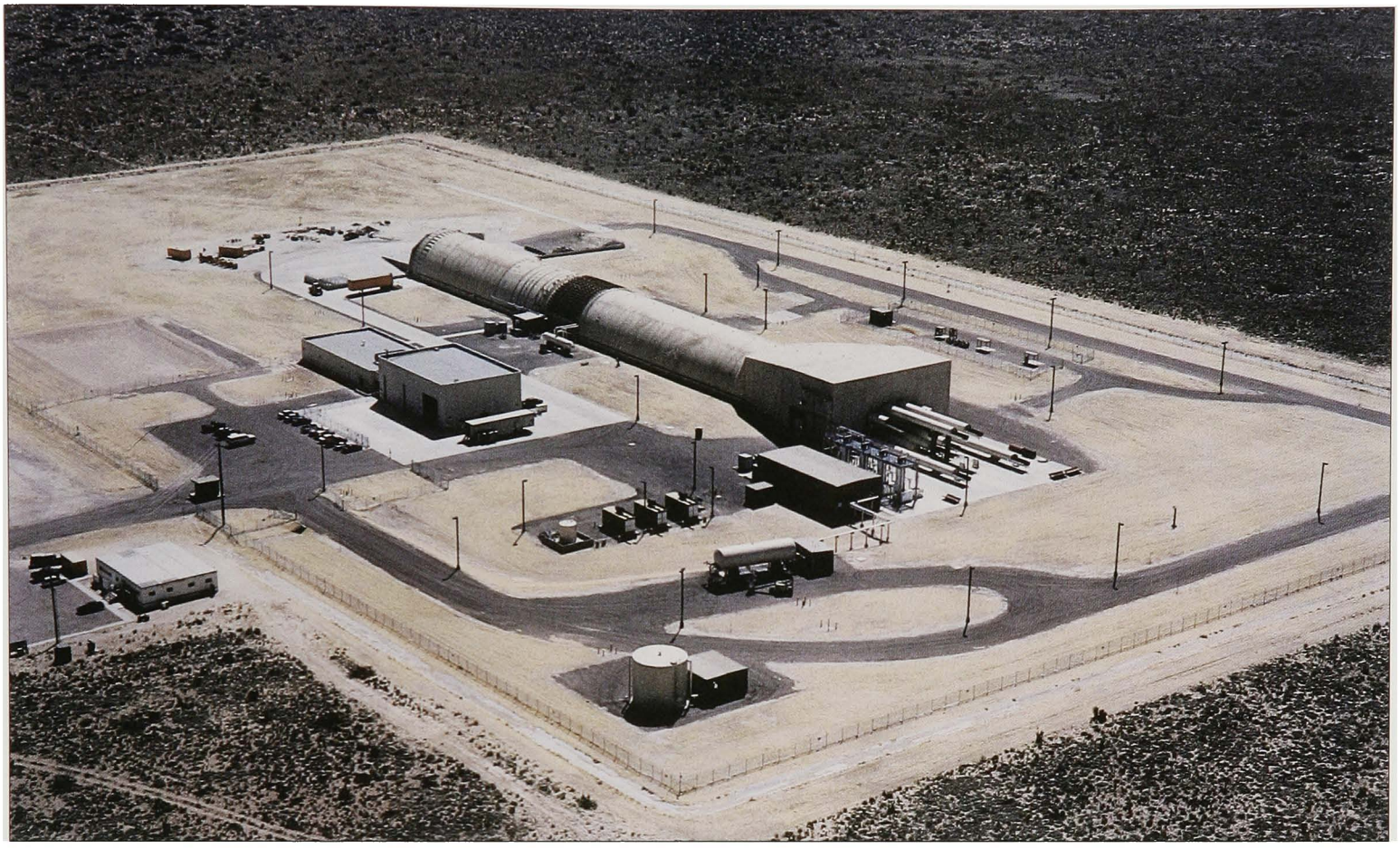
ing and roofing, 1,380 light fixtures, 49 miles of conduit, 3,000 linear feet of carbon steel fuel pipe, 1,380 tons of erected steel, and 2,320 sprinkler heads. The F-117A hangers were the first in the country with in-hangar refueling capability.[25]

Effective partnering by SWD under the command of Brigadier General Robert L. Herndon (1992-1993) helped guarantee the success of the project. SWD, the Albuquerque District, the Air Force, Hensel Phelps Construction, and their subcontractors all worked together to complete the project under budget and ahead of schedule. The facility was built in 530,000 man-hours, all without a single lost-time accident and no outstanding claims or disputes. The project was completed on December 3, 1992, 13 days ahead of schedule, despite over 100 separate modifications to the original contract at a cost of more than $3.6 million.[26] The Albuquerque District's completion of the Stealth hangar project led to its selection by the Air Force as top design agent and top construction agent for 1992.[27]

In the Tulsa District, partnering was a key factor in a project built for the U.S. Navy on a U.S. Air Force base. At Tinker Air Force Base, near Oklahoma City, the Corps constructed a $50-million support facility for seven Navy E-6A aircraft. These sophisticated communications airplanes were crucial elements in the Navy's strategic arsenal. Project design of the facility began in 1986 and included a 900-foot-long, four-bay maintenance hangar with administrative space, a 98,000-square-foot training building, a 57,000-square-foot warehouse, and a 1,300-foot-long taxiway. Because of the number of parties involved, the E-6A bed-down was among the first major military construction projects to use partnering. The Corps' partnering addressed the needs of the Navy, the Air Force, and private sector contractors in the project. Use of partnering helped create an environment in which branches of the military could enhance their fighting capability in an efficient manner.[28]

The Strategic Defense Initiative

During the Reagan presidency, SWD provided support for the Strategic Defense Initiative (SDI), or "Star Wars," a research and development program to create an effective defense against nuclear missile attack. SWD actually had prior experience in anti-ballistic missile (ABM) systems. In 1958, the Albuquerque District had worked with the Army Missile Command to build radar units and launching pads at White Sands for the Nike-Zeus ABM system. The government even-



A Large Blast Thermal Simulator, constructed for the Defense Nuclear Agency at White Sands Missile Range, New Mexico. The simulator is part of the Strategic Defense Initiative (SDI).

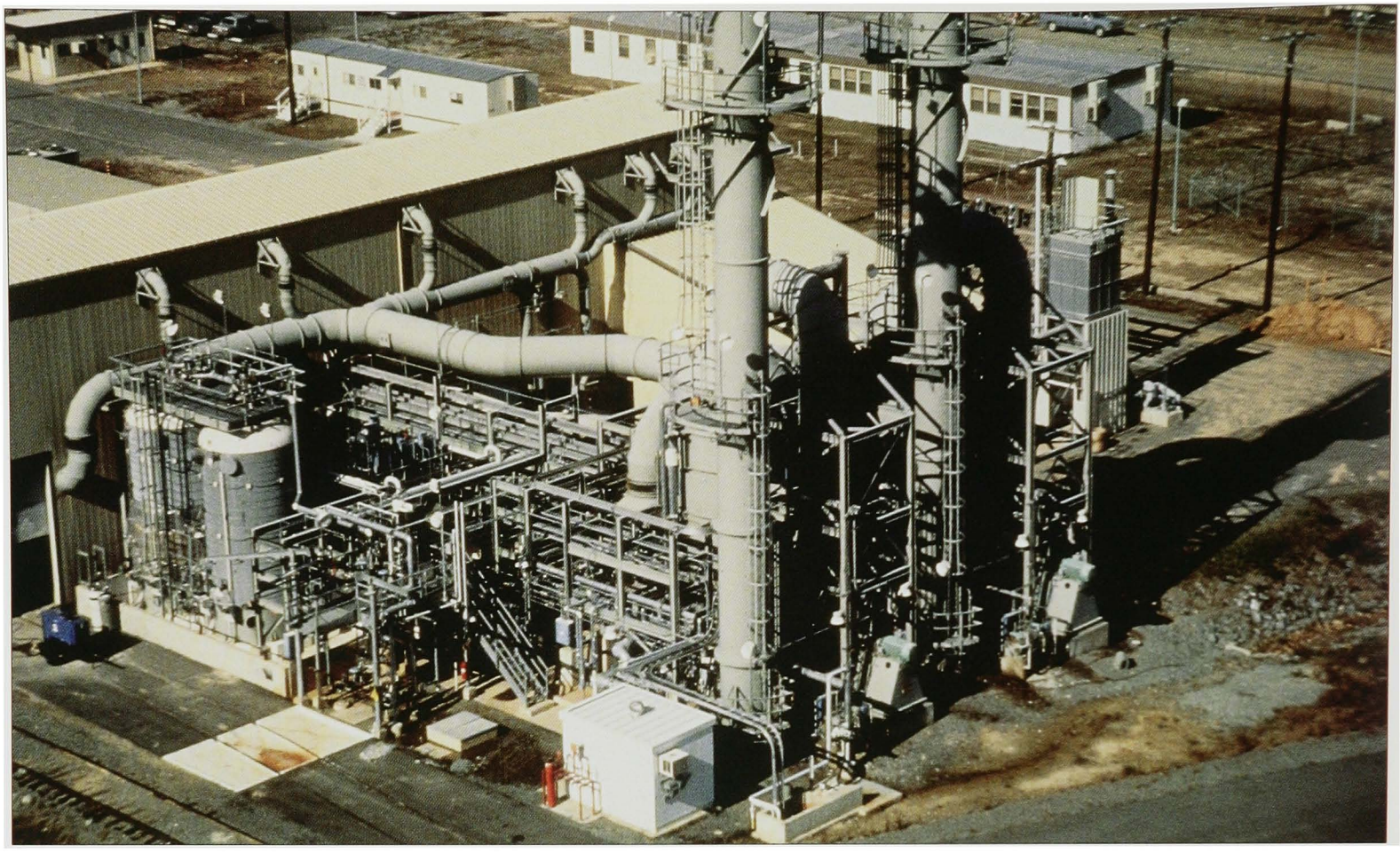
tually abandoned this system when it became clear that such missiles could be overwhelmed by thousands of warheads coming from many directions at once. In early 1983, as part of his famous "Star Wars" speech, President Ronald Reagan resurrected the ABM concept. He called for a long-term program aimed at creating a defense system primarily based in space. The system would employ a "layered" defense to destroy enemy missiles from the time they were launched to just before they reached their targets–a total of about 30 minutes. The incoming intercontinental ballistic missiles would be detected by heat-sensing surveillance satellites. Star Wars satellites or ground-based lasers would then strike at the multiple independent re-entry vehicles before they released their many warheads. X-ray or particle-beam weapons would then attack surviving missiles in space.[29]

In 1981, the White Sands Missile Range became the site for a joint Army, Navy, and Air Force study of military and space applications for lasers. White Sands, one of the oldest U.S. missile test ranges, is located at White Sands National Monument in New Mexico and covers an area about 66 kilometers (41 miles) wide and 201 kilometers (125 miles) long. The Army selected the site in early 1945 because it was secure, flat, and accessible for missile tests. The first missiles tested at what was then called the White Sands Proving Ground were German V-2 rockets captured through the Army's Operation Paperclip in World War II. Paperclip squadrons also detained Wernher von Braun and his team of rocket scientists, who were moved from Europe to White Sands, where they continued their rocket research in laboratories constructed by SWD.[30]

Major components for testing SDI were built at the same White Sands facility. The Albuquerque District constructed a high-energy laser systems test facility (HELSTF) at White Sands for each of the armed services. Capt. Donald L. Hotchkiss, the Corps' office engineer for the job, described the $40 million HELSTF as "one of the highest priority projects in the world."[31] The Corps estimated a savings of $20–$30 million through combined contracting for all three services.

The district's first task was to refurbish three existing domes originally built during the 1960s for work on the Nike-Zeus ABM system. The five-level domes housed computers, main controls, offices, and laboratories. To bring the structures up to current energy standards, they were sandblasted and sprayed with a minimum of 3.5 inches of urethane-foam insulation, and then finished with two coats of silicon.[32]

The largest SDI construction project undertaken in SWD was a new underground auxiliary control room to control



Binary facility at Pine Bluff Arsenal constructed by the Little Rock District in 1986.

lasers remotely and shelter technicians and their equipment during missile tests. The control room had a 9-foot-thick roof slab reinforced with steel plate. The concrete walls were 9 and 10 feet thick, with multiple layers of densely spaced steel reinforcing bars. The project also included construction of three laser test cells, two laser device rooms, a fluid supply system, a pressure recovery system, and support buildings. A 1,016-foot tunnel connected the laser test cells to the auxiliary control room.[33]

In another project at White Sands, SWD became involved in construction of a large blast/thermal simulator (LB/TS) for use in testing the effect of nuclear explosions on land vehicles, helicopters, missiles, and shelters. In 1989, the Fort Worth District was awarded a $1.8 million design contract to work on the LB/TS.[34] Beginning in 1991, the Corps managed the project for the Defense Nuclear Agency. The LB/TS, designed by Ralph M. Parsons Co. of Pasadena, California, can simulate the effects of blasts from nuclear weapons up to an equivalent of 600 kilotons of conventional explosives.[35]

Easing tensions with the Soviet Union and lower defense budgets compelled the Bush administration to reduce funding for SDI, although tests of component systems continue and plans for some form of deployment remain in place. During the Persian Gulf War, computer software developed under SDI guided the Patriot missiles used (with mixed success) to intercept Iraqi Scud missiles. Future SDI funding is uncertain, but even minimal appropriations will probably keep SWD involved in the technology.

Pine Bluff Arsenal

One of SWD's largest and most difficult military construction projects of the late 1980s and early 1990s was the design and ongoing construction of a chemical agents disposal plant at Pine Bluff, Arkansas. The history of chemical weapons extends to World War I, when Germany used canisters of mustard gas at Ypres, France, on the Western Front to disable the enemy. The horrible effects of chemical warfare led to a Geneva convention ban of such weapons from use during World War II. However, several countries continued to manufacture chemical weapons and the systems to deploy them. By the 1970s, these nations had thousands of weapons stockpiled.

The U.S. Army began developing chemical weapons at several sites around the nation before and during World War

II. In November 1941, the Army selected a tract of land in southeastern Arkansas for a chemical research, development, and engineering center. The 14,956-acre parcel was located 30 miles southeast of Little Rock and 8 miles northwest of the city of Pine Bluff. Initially, the Army used the Pine Bluff Arsenal to manufacture the revolutionary insecticide DDT (dichloro-diphenyl-trichoroethane), but eventually it began manufacturing and storing a variety of chemical weapons there. These weapons included mustard and nerve gases.[36] Some of the nerve agents were so lethal that one drop on exposed flesh could kill within minutes.[37]

Chemical weapons development continued at Pine Bluff until 1968. The chemical agents were contained in rockets, mines, bombs, and artillery shells that ranged in age from 22 to 46 years. Disposal issues soon arose. Some agent containers were deteriorating and beginning to leak, whereas others were so obsolete that the weapons for firing them no longer existed. The volatile nature of chemical weapons made transfer to other sites risky. At the same time, environmental concerns stood in the way of underground disposal.[38]

By the 1980s, international pressure added emphasis to efforts for reduction of chemical weapons arsenals in the United States and Soviet Union. In 1985, new federal legislation required that all chemical weapons in the U.S. arsenal be replaced with new "binary" chemical weapons technology.[39] These weapons contain two separate chemicals that are harmless until they are combined. As a result of the new policy, the Little Rock District began work on a $100 million binary chemical weapons production facility at the Army's Pine Bluff Arsenal.[40] The shift to binary weapons was short-lived, however, as continuing international pressure prompted both superpowers to develop programs for destroying most chemical weapons by the end of the century. The Army assigned this task to its Toxic and Hazardous Materials Agency, based at the Aberdeen Proving Ground in Maryland.[41]

The U.S. stockpile of chemical weapons, estimated at 70 million pounds, presented an enormous problem for the DOD. Safe storage was costly, risky, and, at best, only a temporary solution. DOD officials therefore concluded that the safest and most efficient method for disposal was on-site incineration at Pine Bluff and the eight other sites around the nation where chemical agents were stored. On 3 February 1988, an Army record of decision declared that all chemical weapons should be incinerated at their storage locations.[42]

The Army had been experimenting with disposal of chemical weapons in an ecologically safe manner since the late 1960s. The first Army chemical weapons disposal unit was built at the Rocky Mountain Arsenal in Colorado. A larger chemical agent disposal system was constructed at Tooele Army Depot, Utah, where approximately 42 percent of obsolete



The Pine Bluff Arsenal stores chemical weapons containing the nerve gases GB and VX.

chemical weapons stock were stored. Both facilities successfully used incineration to dispose of the weapons. The Army considered enlarging the Utah site to incinerate all obsolete weapons, but rejected the idea after opposition arose to overland or air transport of deteriorating chemical weapons.[43]

While debate continued on methods of disposal, Army officials continued to develop on-site incineration technology. At remote Johnston Atoll, a U.S. territory in the western Pacific Ocean 800 miles southwest of Hawaii, the Army constructed the Johnston Atoll Chemical Agents Disposal System (JACADS). This became the prototype facility for planned incinerators at Tooele, Utah; Umatilla, Oregon; Pueblo, Colorado; Newport, Indiana; Lexington-Blue Grass, Kentucky; Anniston, Alabama; and Pine Bluff. During the 1970s, the government sent large shipments of obsolete chemical munitions from a stockpile at Okinawa to Johnston Atoll.

In 1984, construction began on the $371-million JACADS facility at the remote atoll. As designed, JACADS would use a computerized, five-stage incineration process in which munitions were punctured robotically and then incinerated at temperatures of up to 2,700 degrees Fahrenheit. After incineration, all that remained of the chemicals would be inorganic salts and scrap metal. The JACADS facility was scheduled to begin full-scale operation in 1989, but after technical difficulties the Army changed the start-up date to September 1991. By 1993, after a series of test burns at Johnston Atoll, Army officials declared JACADS safe and fully operational. One Corps official optimistically declared "that more than 5,000 years of operation of a JACADS-type facility would likely occur without fatality to a member of the public."[44]

At the Pine Bluff facility, the Army started destroying chemical weapons in May 1988. The Corps designed and built a 10-acre plant to incinerate 94,000 pounds of a non-lethal chemical agent called BZ (3-quinuclidinyl benzilate), an obsolete hallucinogen originally developed to incapacitate the enemy.[45] Disposal of lethal chemical weapons at Pine Bluff, however, posed a much greater challenge. Pine Bluff housed 12 percent of the nation's chemical weapons stockpile, including 115,000 missiles and 50,000 pounds of chemicals.

While construction and testing took place at Johnston Atoll, SWD initiated plans for building a similar incinerator for the destruction of the lethal chemical weapons at Pine Bluff Arsenal.[46] In 1990, Little Rock District started design work on support facilities for the Chemical Demilitarization Project.[47]

Construction of such a disposal system generated concern in the community surrounding Pine Bluff Arsenal. There were reports that the emergency response program for areas surrounding the arsenal was inadequate. Greenpeace representatives, unconvinced that the JACADS facility was being properly monitored for emissions, expressed open concern about incinerators at the other seven sites. However, a report by the Mitre Corporation, an independent contractor employed by Congress to evaluate the JACADS facility, concluded that the plant would be safe and that the risks of an accident were extremely low. Moreover, a Department of Energy impact review stated that the worst accident risk, 1 in 100,000,000, was from an airplane crashing into the site. Other studies calculated risks for everything from earthquakes to tornadoes and meteors.[48] SWD moved ahead with the permit process and oversaw construction of a $2 million off-site communications center, completed in 1993. Construction of the incinerator was scheduled to begin in January 1995; however, approval permits have not yet been obtained.

Base Realignment and Closure

A soaring federal budget deficit and the easing of Cold War tensions combined to spearhead a general downsizing of the armed forces by the early 1990s. The Pentagon responded, in part, with a proposal to reduce its active duty forces by 25 percent from a high of 764,000 in 1990 to 580,000 by 1997. The reductions in force had significant implications for the nation, the armed forces, and the Corps. Nationally, many elected officials rejoiced over the prospect of reduced defense spending, heralding the coming of a "peace dividend" for the American people. For millions of people with defense-related employment, however, reduced defense spending meant severe economic dislocations. For the armed forces, downsizing meant not only reductions in force, but also that many of its facilities around the nation and the world were no longer needed. The Corps played a major part in dealing with the physical aspects of downsizing military installations through what became known as the Base Realignment and Closure (BRAC) program.[49]

To oversee the BRAC process, President George Bush appointed an eight-member Defense Base Closure and Realignment Commission with the power to add or delete bases from the DOD list.[50] The list was then subject to review by the President, who either approved or rejected the list in its entirety. If the President approved the list, Congress had 45 days to act on the recommendations. Rejection of the list required a majority vote in both congressional chambers. If Congress did not act within the allocated time, the closures automatically went into effect. Following approval, bases on the list had at least one year to prepare for closure. All bases on the list had to be closed in six years.[51]

In 1990, the Pentagon issued a list of 35 bases and facilities designated for closure. Within SWD, these included Bergstrom Air Force Base near Austin, Texas; Carswell Air Force Base in Fort Worth, Texas; Chase Field Naval Air Station in Beeville, Texas; Fort Chaffee in Fort Smith, Arkansas; Eaker Air Force Base in Blytheville, Arkansas; and the Naval

Weapons Evaluation Facility in Albuquerque, New Mexico. The White Sands Missile Range was the only SWD installation scheduled for realignment or reduction. Compared to the rest of the nation, SWD was less affected by the first round of BRAC cuts. The warm climate of the region was partly responsible. Defense Department officials and the BRAC Commission recognized that installations in the Southwest afforded far more training days per year than those located in colder or wetter parts of the nation.[52]

Once under way, the BRAC program immediately encountered resistance. Large military facilities not only housed thousands of military personnel but also supported numerous civilian service industries in the surrounding communities. Few community leaders accepted the BRAC Commission's recommendations when nearby bases were targeted for closure. Elected representatives were also often against base closures or reductions that affected their constituents. Marvin Leath, a representative from Waco, Texas, and a member of the House Armed Services Committee, commented that the BRAC list had outraged Congress and "created a Frankenstein's monster that [would] walk back across the [Potomac] river and devour something."[53]

Deliberations on bases targeted for closure continued as President Bill Clinton succeeded President Bush in 1993. In SWD, the Dallas Naval Air Station, a base added in the second phase of the Pentagon's realignment and closure program, was among the first to begin the process of shutting down. This station had a staff of 2,567 full-time military and civilian personnel, a large portion of whom would be reassigned to Carswell Air Force Base in Fort Worth. The BRAC Commission continued its work into 1995, and base closings remain a pointed political and economic issue throughout the nation.

Environmental issues also play a major part in the BRAC process. Many defense sites are polluted and must be cleaned up before they can be turned over for civilian use. The Corps oversees cleanup and restoration of Army, Navy, and Air Force sites through their Formerly Used Defense Sites (FUDS) program and Installation Restoration Program (IRP). Both FUDS and IRP are part of the Corps' Defense Environmental Restoration Program (DERP).[54]

In SWD, the Tulsa District's Geotechnical Branch started working on environmental cleanup before DERP, IRP, and FUDS. The district was involved in early hazardous/toxic waste site investigations and cleanup program design. At Pine Bluff, for example, the Geotechnical Branch oversaw a 1986 Hazardous Landfill Closure Site project. In 1989, Tulsa was named as the hazardous/toxic waste design district for SWD by Corps headquarters. To meet their added responsibilities, the district added 27 new positions, including geologists, chemists, industrial hygienists, physical scientists, and chemical, environmental, and civil engineers. Tulsa's experience in environmental cleanup gave SWD a head start in fulfilling Chief of Engineers Lieutenant General Henry Hatch's goal of becoming "an agency that is rightly concerned about the environment and willing to take a step beyond simply complying with environmental law."[55]



SWD's military construction program underwent significant change during the 1980s and 1990s, as the country moved from military buildup under Ronald Reagan to downsizing following the collapse of the Soviet Union. Projects included major hospital construction, military housing, and support facilities at armed forces sites throughout the area of operations. SWD also played a major role in construction of Strategic Defense Initiative technologies. As the Cold War ended, the division participated in the disposal of chemical weapons and the DOD's Base Realignment and Closure Program. The Corps' SWD used pioneering new program management and partnering methods, along with traditional engineering skills, to meet the challenges of radically changed armed forces military construction requirements of the 1990s.

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Chapter Three:

Supporting the Nation:

Civil Works Activities

During the 1980s and early 1990s, SWD adapted to meet regional needs in its civil works program. The Albuquerque, Fort Worth, Galveston, Little Rock, and Tulsa districts were all involved in a variety of civil works activities, including flood control, navigation, and shore protection. Division personnel supported these activities with both traditional and innovative management techniques, providing financial monitoring, quality assurance, and liaison services. Among the most pressing civil works challenges of this period in SWD were urban flood protection, deep-water and inland navigation improvements, water supply and quality, and the completion of multipurpose reservoirs.

SWD's experiences during the 1980s and early 1990s reflected broader trends in federal water resources development. The entire civil works program of the Corps underwent important transitions throughout this period. For the first time in Corps history, expenditures for operation and maintenance of civil works facilities exceeded expenditures for general construction. This trend was particularly evident in SWD, where operation and maintenance expenditures first exceeded general construction in fiscal year 1983, and did so every year thereafter. From 1986 to 1994, SWD operation and maintenance expenditures increased from $181.2 million to $250.4 million.[1]

Several legislative and administrative initiatives caused a general reshaping of federal water resources policy and practice during those years. Most important was passage of the sweeping Water Resources Development Act of 1986 (WRDA-86), the first significant omnibus water resources legislation since 1970. WRDA-86 authorized more than 300 Corps water resources projects, totaling $16 billion, and deauthorized 293 projects that would have cost approximately $11 billion. The 1986 legislation had many more significant provisions that altered the agency's methods of planning and designing projects. Corps planners also had new guidelines to follow, promulgated in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (P&G) of 1983. These guidelines superseded the *Principles and Standards for Planning of Water and Related Land Resources* (P&S) of 1973, which established the dual objectives of environmental quality (EQ) and national economic development (NED). The 1983 P&G made NED the sole objective of water resources projects.

Fiscal and environmental factors also affected the Corps' civil works activities. Presidents Ronald Reagan and George Bush, although generally favoring federal water resources development, presided over Congresses determined to reduce federal spending. Budget-minded Congressmen not only opposed many federal water projects, they also ushered in an era of reductions, or downsizing, of federal agencies. The Corps responded to this new era with reorganization plans that called for fewer personnel and the closing of some field offices. George Bush's successor, President Bill Clinton, initiated efforts to "reinvent" government and called for streamlining agencies and functional efficiencies.

Environmental issues arising in the 1960s and 1970s continued to affect the Corps' civil works program during subsequent decades. To comply with environmental laws such as the National Environmental Protection Act (NEPA), Corps planners had to consider many factors, including nonstructural alternatives in flood control and impacts on plants and wildlife. The number of public and private interests involved in civil works planning increased dramatically in the post-NEPA era, when all activities required extensive public review and participation. The Corps pioneered public involvement techniques in the 1970s, and refined those methods while working with residents, local and state governments, and federal agencies such as the U.S. Fish and Wildlife Service and the Environmental Protection Agency. Corps divisions not only provided technical assistance to districts regarding environmental issues, they often provided a forum for bringing groups together to work on the complexities of civil works planning.

Changes related to civil works in the Corps' divisions were profound during the 1980s and 1990s. The continued transition within the divisions from engineering and technical review to program and project management reshaped the Corps' entire divisional structure, giving division personnel new responsibilities both in military construction and civil works activities. The provisions of WRDA-86 required increased non-federal participation in planning and construction of water projects. Division members increasingly assumed the role of liaison among the interested parties. Divisions also

increased their function as a conduit for information to and from Corps headquarters, the Office of the Assistant Secretary of the Army for Civil Works, Congress, and the districts.

During this time of fundamental change, division and district personnel struggled to meet new requirements while upholding the Corps' traditional mission of water resources development. In SWD, diverse civil works demands ranged from coastal shore protection and deep-draft navigation along the Gulf of Mexico to unique flood control and water supply projects in the semi-arid mountains of New Mexico. The following cross-section of projects and other activities from throughout the area of operations illustrates how SWD responded to the changing times.

Reservoir Construction

With completion of the McClellan-Kerr navigation system and the abandonment of plans for a Trinity River waterway during the 1970s, SWD witnessed the end of large-scale reservoir and lock and dam construction. The environmental and fiscal constraints and local opposition that made the Trinity River waterway unfeasible also affected other planned dam projects.[2] During the long congressional impasse extending from the 1970s into the 1980s, many authorized projects did not receive funding. By the late 1980s, however, a few environmentally acceptable projects received funding and progressed. In northern Texas, several reservoirs, either completed or under construction, provided flood protection, water supply, and recreational needs for the rapidly urbanizing north central part of the state. In Oklahoma, the Corps completed Arcadia Lake to provide flood control, water supply, and recreation for residents in the Oklahoma City metropolitan area. In southeastern Texas, the Corps was in the process of building a reservoir and lock and dam to facilitate navigation and prevent salt water incursion to inland areas.

Cooper Lake

The origins of the Cooper Lake project in north central Texas extended back to the Franklin D. Roosevelt administration and the Corps' "big dam era." The sweeping Flood Control Act of 1936 authorized surveys for dozens of regional

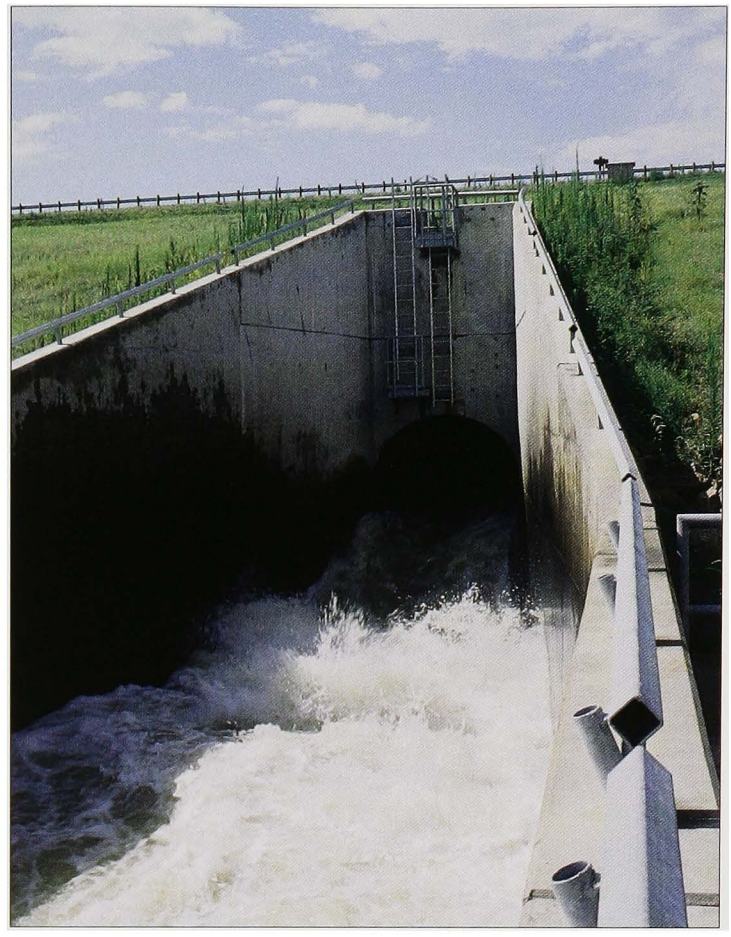


Construction of Cooper Dam (northeastern Texas) during the late 1980s.

flood control projects throughout the country. One survey involved the South Sulphur River near the town of Cooper, Texas, about 90 miles east of Dallas.[3] In 1937, the Corps produced plans for a multipurpose reservoir along the river for flood protection, water supply, and recreational facilities. Cooper Lake would provide water for the often dry countryside of northeastern Texas, while also protecting Delta, Hopkins, and Hunt counties from flooding.[4] Congress approved the project in August 1955, and construction of the channel and levee improvement portions began in July 1958 under the management of the New Orleans District.

Work on the Cooper Lake project came to an abrupt halt in 1971 following passage of NEPA. NEPA required an environmental impact statement (EIS) for all federally funded projects. Although substantial portions of the Cooper Lake project were complete, the U.S. District Court for Eastern Texas ordered that further construction cease until the Corps prepared an EIS for the project.[5]

Few federal agencies were prepared for full compliance with the new environmental legislation. The Corps responded in several ways. First, it hired more nonengineers, including biologists, environmental scientists, and sociologists. Second, through its newly established Institute for Water Resources, the Office of the Chief of Engineers began a public involvement program to assist field personnel in conducting the required public review of environmental documents.[6] Third, the Corps established an environmental advisory board to the Chief of Engineers that consisted of prominent environmental experts from around the nation. Lastly, the Corps developed environmental guidelines for field personnel to follow in planning and designing civil works projects.[7]



The spillway, Cooper Dam, 1992. Cooper Lake provides flood control, water supply, and recreation for residents of northeastern Texas.

Preparation of environmental statements was a new and difficult process for Corps field operating agencies, particularly regarding projects already under construction.[8] The New Orleans District submitted an EIS on Cooper Lake in 1977. However, the U.S. District Court ruled the statement inadequate and continued to prohibit further construction.[9]

In 1979, the Corps of Engineers realigned some district boundaries. As a result, the Fort Worth District now assumed responsibility for the Cooper Lake project. The Fort Worth District completed a Supplemental EIS in 1981, but the court injunction stood until July 1984, when the process ended. Deliberate impoundment of water at Cooper began in 1991.

Cooper Lake can hold 131,400 acre-feet of water, providing flood protection for 12,900 acres of agricultural land. The lake's water storage capability is 273,000 acre-feet of water, providing 109 million gallons per day to the North Texas Municipal Water District, the Sulphur River Municipal Water District, and the city of Irving. South Sulphur Park and Doctors Creek recreation sites, located on the southern and northern sides of the lake, have boat ramps, campsites, picnic sites, and beach areas.[10] The lake and surrounding recreational facilities cover an area of 56,877 acres, with over 34,000 acres devoted to fish and wildlife. When Cooper Lake opened in November 1992, fishermen rushed in, eager to catch largemouth bass and catfish. Cooper's immense popularity among sports enthusiasts reflects the recreational importance of Corps lakes in SWD.[11] The flood control benefits of the lake soon became evident as well. During December 1992, heavy rains transformed the conservation pool to an essentially full reservoir. In less than a month, 19,000 acre-feet of water collected in Cooper Lake.[12]

Joe Pool and Ray Roberts Reservoirs

Both Joe Pool and Ray Roberts Reservoirs were part of the proposed Trinity River waterway. Although the Corps had planned for construction of the waterway linking northern Texas to the Gulf of Mexico, in 1973 voters in the Dallas-Fort Worth area rejected a bond initiative for the local community's share of funding.[13] However, the Corps did complete some components of the waterway, including the Joe Pool and Ray Roberts reservoirs, which were authorized under the River and Harbor Act of 1965 and funded by Congress in 1977.[14]

SWD's Fort Worth District constructed impoundment structures for Joe Pool Lake (above and below)...

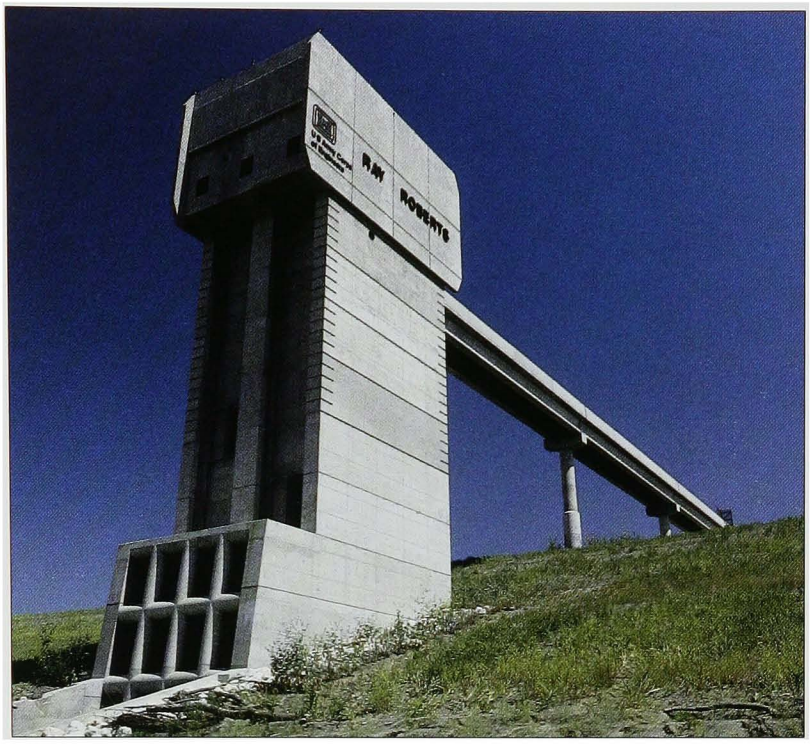


...and Ray Roberts Lake (above).

The rapid growth of the Dallas-Fort Worth metroplex favored construction of the Joe Pool project even after support for the Trinity River waterway ended. [15] The dam site was along Mountain Creek, a tributary of the West Fork of the Trinity River. The proposed reservoir, on the border of Dallas and Tarrant counties, would provide flood protection for Grand Prairie and portions of southeastern Dallas. The project also had water supply and recreation benefits.[16] Dam construction began in 1975. An earth-filled embankment 22,360 feet long, impounding a reservoir with a 304,000 acre-feet of capacity, the dam would provide 35-year flood protection (i.e., an estimate that flood waters would exceed the capacity of this project once in 35 years). The project provided flood protection for 33,000 acres of urban development in Grand Prairie and Dallas valued at $1.25 billion.[17] By the end of fiscal year 1993, even before its official completion in late 1994, the Joe Pool Reservoir had already prevented more than $403 million in accumulated flood damages.[18] Joe Pool also supplied water to Grand Prairie, Cedar Hill, Duncanville, and the Midlothian Water District. At its capacity of 304,000 acre-feet, Joe Pool could provide up to 14.2 million gallons of water daily.[19] The lake's water area covers 7,500 acres, with three major parks surrounding it. After opening for public use in 1987, Joe Pool quickly became one of the top recreational lakes in Texas. The town of Grand Prairie experienced significant economic development as the number of retail shops increased to accommodate numerous visitors.[20]

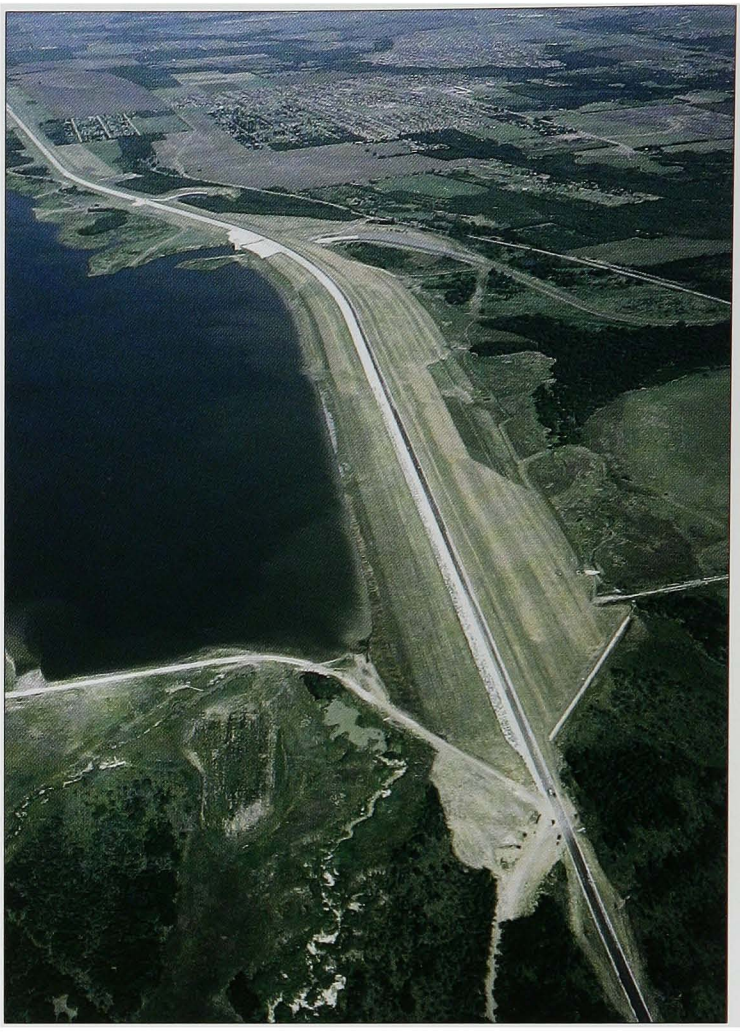
Ray Roberts Reservoir is located in north central Texas in the counties of Cooke, Denton, and Grayson, along the Elm Fork of the Trinity River, between the towns of Sanger and Aubrey. [21] Arguments in favor of building Ray Roberts Reservoir were many. In addition to flood protection benefits, the proposed reservoir would supply water for residents in north central Texas. Also, its flood control capability would improve the water supply benefits of Lewisville Lake, 30 miles to the south. In addition, the northern dam would impound water, allow sediment to settle, and release the cleaner water under controlled conditions. At the request of the city of Denton and with the approval of the Secretary of the Army, the Corps constructed a penstock for hydropower.[22]

Construction on Ray Roberts began in the early 1980s. The dam was a 14,965-foot long earth-filled embankment. The reservoir could hold slightly more than 1 million acre-feet and supply up to 74.3 million gallons of water per day. Impoundment of water at Ray Roberts began in June 1987. By November 1988, the Corps had raised the level of Lewisville Lake by seven feet, greatly increasing the water supply of that reservoir.[23] The lake opened for recreational use in January 1990. Four days later, winter rains entirely filled the reservoir. The reservoir prevented more than $800 million in flood damages on a $317.5 million investment.[24] In 1991, the city of Denton completed its 1,000-kiowatt hydropower facility using non-federal funds.[25]

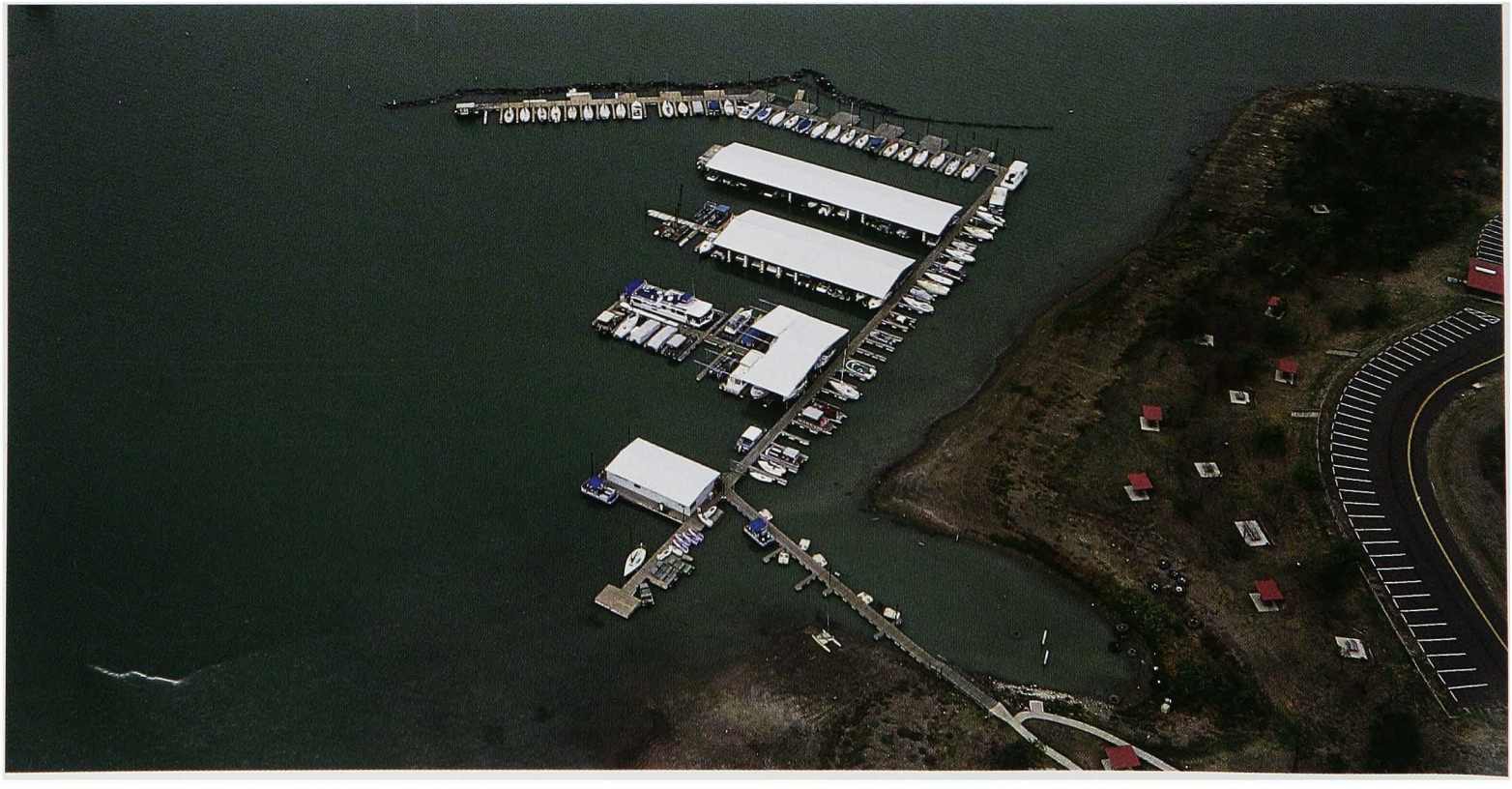


Ray Roberts Lake (above)

SWD personnel enhanced the recreational and environmental value of the project by developing a plan to buy land between Ray Roberts and Lake Lewisville. Authorized in the Water Resources Development Act of 1990, the plan called for the creation of a greenbelt corridor between the lakes.[26] The cities of Dallas and Denton were already obligated to provide recreational facilities for Lewisville, and agreed to the Corps' plan to substitute the greenbelt for their original recreation design. In 1993, the cities purchased or acquired use permits



Joe Pool Lake (above and below) and Ray Roberts Lake (following page) provide the Dallas-Fort Worth metroplex residents with flood control, water supply, recreation, and hydropower benefits.







for approximately 1,600 acres of land. The plan for the greenbelt incorporated hiking trails, primitive camping areas, and canoe launching facilities, with development costs shared equally by the federal government and the local sponsor.[27] Like Cooper Lake, Joe Pool and Ray Roberts reservoirs were important elements in providing residents of northern Texas with flood protection, water supply, recreational opportunities, and potential hydropower.

Arcadia Lake

Arcadia Lake, located in the Tulsa District area of operations, impounds water from the Deep Fork River in northern Oklahoma County. As the Oklahoma City metropolitan area grew after World War II, once remote communities like Norman, El Reno, and Edmond became suburbs of the state capital. As a result, urban development encroached into flood-prone areas throughout Oklahoma County, including the Deep Fork River basin near the city of Edmond. In addition, the growing population demanded more water than existing sources could supply.

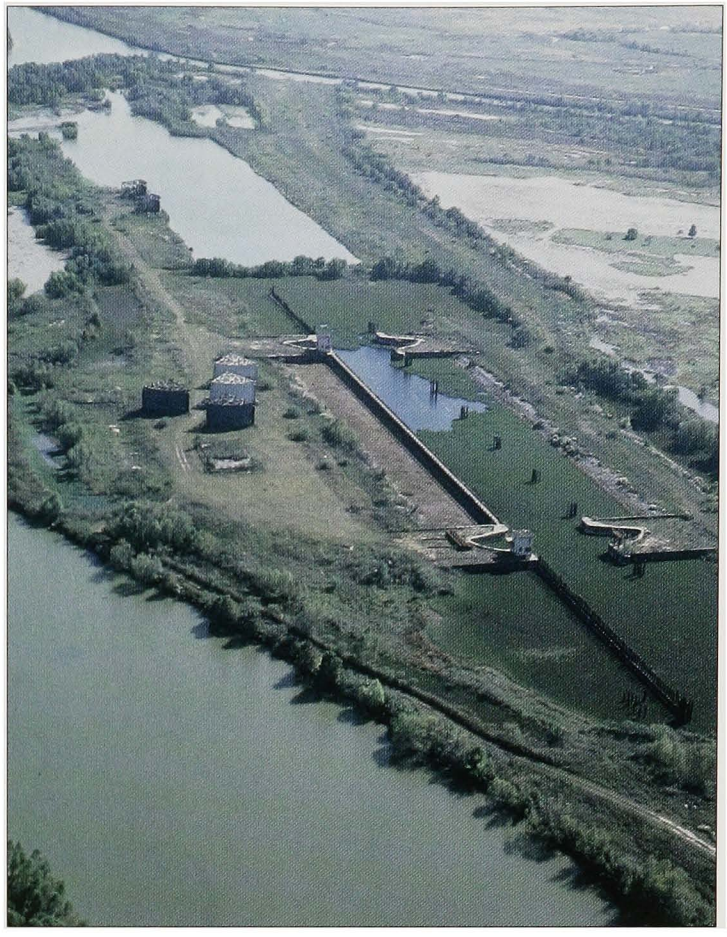
Congress originally authorized the reservoir in the Flood Control Act of 1970 as a flood control, water supply, and recreation project. Arcadia was one of only four new construction starts in the entire nation during the administration of President Jimmy Carter (1978-1981).[28] In October 1980, construction began on the 5,250-foot long, 103-foot high earth-fill dam approximately 1.5 miles from the town of Arcadia. The outlet facilities included an uncontrolled spillway, a gated tower, and a conduit. The Corps completed construction of the dam in November 1986, which eventually impounded an 1,820-acre-foot reservoir.[29]

After completion of the project, controversy arose. During construction, the total dollar figure for recreation costs associated with the reservoir had risen because of inflation, although the percentages for federal and non-federal contributions had remained the same. The local sponsor, the City of Edmond, believed that the amount of local cooperation should have remained at the original dollar estimates. Ultimately, both recreation and water supply costs became disputed. With Edmond and the Tulsa District at odds, SWD personnel stepped in to resolve the issue. The division commander, Major General Jerome B. Hilmes (1985-1988), argued that the local sponsor's increased contributions were legal and mandatory. Hilmes's position angered Edmond officials and members of the Oklahoma congressional delegation such as Representatives Wes Watkins and Mike Synar.[30]



The dam for central Oklahoma's Arcadia Lake (Tulsa District) was completed in 1986. Soon after, the State of Oklahoma and the federal government became embroiled in a financing dispute over recreational facilities.

The dispute with the City of Edmond continued throughout the 1980s. During this time, SWD referred the case to the Department of Justice.[31] When the city finally refused to reimburse the federal government for recreational and water supply costs, the government filed suit in the U.S. District Court for the Western District of Oklahoma.[32] Under the aegis of the Department of Justice, Division Engineer Brigadier General Stanley G. Genega led a division team that presented the federal government's case to the district court in 1991. After reviewing the case, District Judge Wayne C. Alley called all parties into his office. He informed city officials that the federal government's case was compelling, and urged them to settle before going to trial. In February 1992, all parties signed a consent decree by which the City of Edmond and the Edmond Public Works Authority agreed to reimburse the federal government $7.2 million over a 40-year period for recreation works, and $16.3 million over a 43-year period for water supply works.[33]



Locks at Wallisville Lake (Galveston District) were left incomplete with the gates sitting at the shore. A 1973 injunction prevented further work until a supplemental EIS covered the deficiencies in the original EIS.

Wallisville Lake

Another component of the Trinity River Waterway was a proposed reservoir approximately 40 miles northeast of Houston, Texas. As plans for the waterway unfolded in the 1950s and 1960s, landowners, especially rice growers between the town of Liberty and the Anahuac National Wildlife Refuge, grew concerned that the navigation channel would allow salt water to flood their lands. Galveston District officials reviewed the situation, and proposed that a reservoir be added to the waterway south of Liberty that would serve as a barrier against salt water intrusion. Wallisville Reservoir would be located in Chambers and Liberty counties, 3.9 miles above the mouth of the Trinity River and south of the town of Liberty. In October 1962, Congress authorized construction of the 19,700-acre lake for the purposes of salinity control, navigation, water supply, fish and wildlife enhancement, and recreation. Water supply was particularly important, with both the Corps and the City of Houston predicting a doubling of regional water consumption by 2010. The proposed earthen dam was to be 39,200 feet long with a 22,325-foot overflow section. The result would be a shallow, 4-foot-deep reservoir covering 19,700 acres.[34] The Wallisville project also incorporated plans for a navigation lock 84 feet wide, 600 feet long, and 16 feet deep.[35]

Construction of the lake began in 1966, just as the environmental movement was burgeoning in the United States. In April 1971, the Sierra Club, Houston Sportsmen's Club, Audubon Society, Texas Shrimp Association, and two individual fishermen filed suits against the Corps to stop work on the Wallisville project.[36] The plaintiffs claimed that the Corps had failed to meet the EIS requirements of NEPA. Opponents of the project feared that the dam would flood a rare cypress swamp and destroy Galveston Bay marine life by blocking supplies of fresh water. In response to the lawsuit, Fifth Circuit Federal District Judge Carl Bue ruled for the plaintiffs. Construction came to a halt in 1973, with the dam 90 percent complete.[37]

After litigation lasting more than a decade, the U.S. Court of Appeals approved resumption of the project in 1987. By then, however, the new cost-sharing rules of WRDA-86 required additional local funding participation and therefore halted construction. Division personnel played an important role in resolving the environmental and financial issues that prevented Wallisville from moving forward. In particular, they acted as moderators in the conflict between the Galveston District and other federal agencies such as the U.S. Fish and Wildlife Service. Under the leadership of Brigadier General Robert C. Lee, division engineer from 1988 to 1990, SWD personnel also helped to raise the level of public involvement regarding the Wallisville project.[38] During the fall of 1989, Congress designated $4 million for the project for fiscal year 1990, and the Bush administration promised an additional $9.2 million in 1990 that became available in 1991 as part of the Energy and Water Development Appropriations Act.[39]

Despite allocation of funds, opposition to the dam continued. As an alternative, critics urged that an inflatable barrier be installed to block salt water when the Trinity was low.[40] Supporters of the reservoir project also spoke out. Former



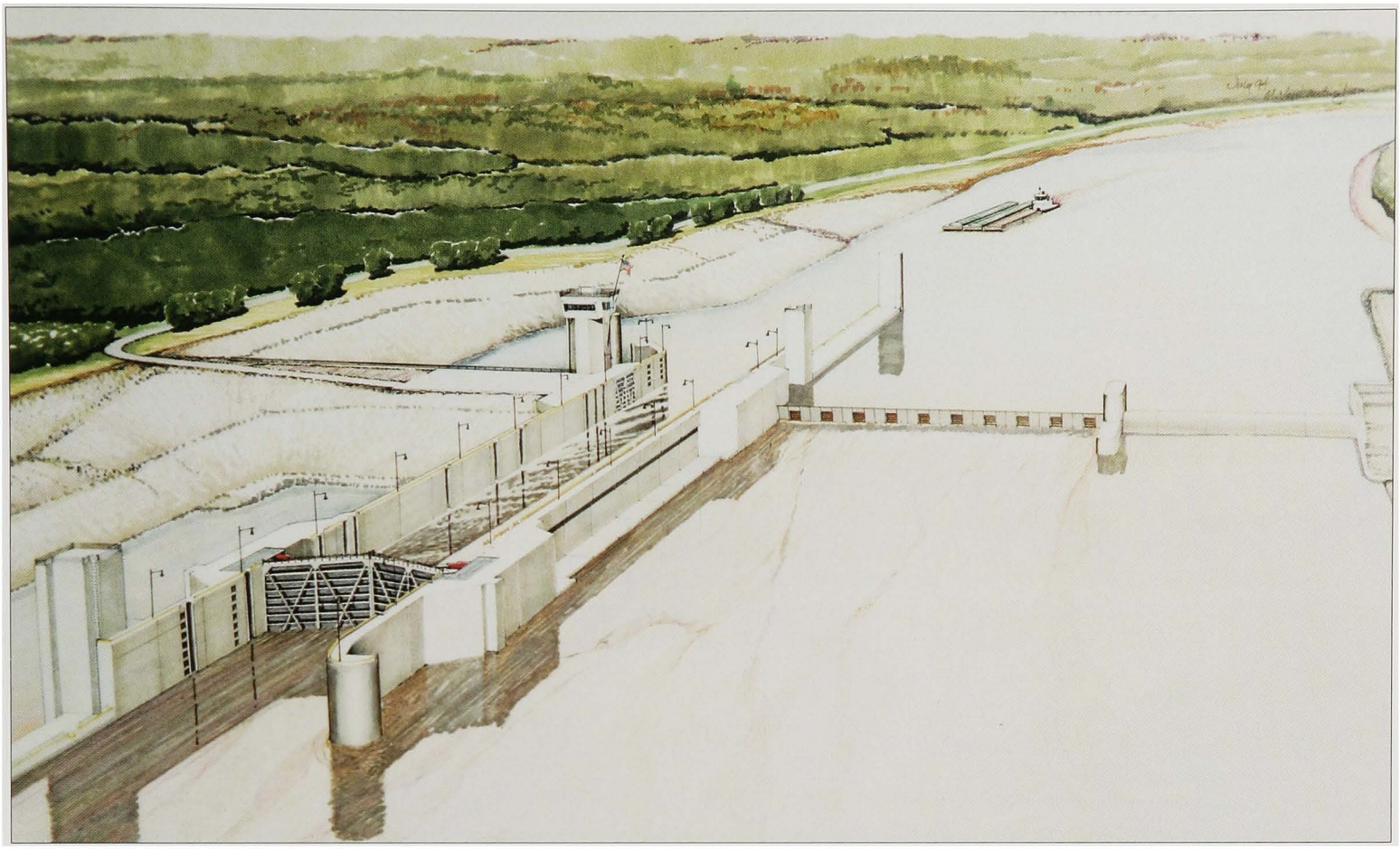
Wallisville Lake in 1991. The project created a multi-purpose lake on the lower Trinity River in southeastern Texas.

Texas governor Price Daniel, a Wallisville landowner and proponent, stated that those who opposed Wallisville would probably also have fought construction of the Houston Ship Channel. He recalled that critics of the ship channel regarded the project as "an idiotic venture of a pack of troglodytes playing engineer."[41]

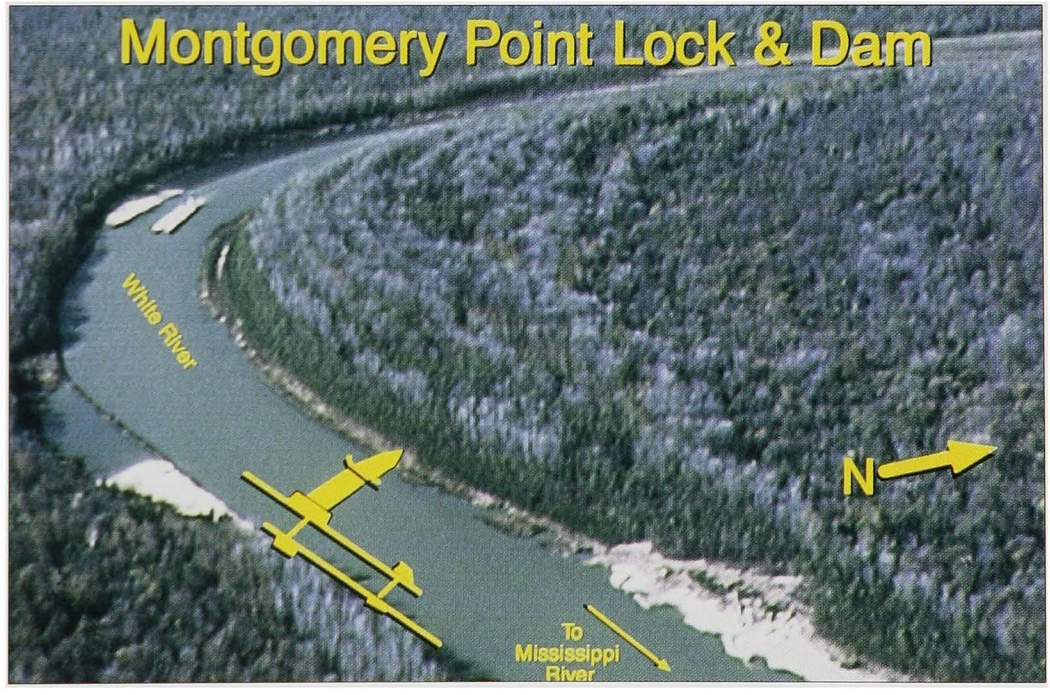
Construction of Wallisville resumed in September 1991, when the Corps awarded a contract to build a nonoverflow dam on the west banks of the Trinity River at a cost of $1.7 million. District Engineer John P. Basilotto oversaw the redesign of Wallisville to reduce the reservoir area to 3,800 acres, with a normal pool of 2 feet above mean sea level and a storage capacity of 14,000 acre-feet. Several factors, including protection of a bald eagle nesting area located in a cypress swamp near Lake Charlotte, preservation of the swamp itself, and potential impact on shrimp populations, led to the 5,000-acre size reduction.[42] The new project provided for a dam and overflow spillway approximately eight miles long, and also included an 84-foot by 600-foot lock to facilitate navigation on the channel to Liberty, Texas. The $65-million project also provided for two recreational areas. In December 1995, the Corps awarded the last major contract to rehabilitate the lock and complete the embankment and other facilities.[43] The smaller reservoir meant less flood control capability, water supply, and recreational use, but public demands had changed since the original project planning took place. Environmental concerns and cost-sharing compelled the Corps to make the unusual decision to alter a project that was 90 percent complete.

Navigation Projects

The Wallisville Reservoir project exemplified the complexity of navigation issues in SWD. Three of the five SWD districts (Galveston, Little Rock, and Tulsa) maintained extensive navigation facilities, the Galveston District having both inland and deep water works. Balancing economic needs and environmental concerns became increasingly challenging during the 1980s and 1990s as the demands for maintaining and improving navigation often clashed with environmental concerns. Moreover, new legislation changed the traditional way of doing business between the Corps and commercial navigation.



An artist's rendering (above) of Montgomery Point Lock and Dam (Little Rock District). Below, a superimposed photo of the project drawn in 1993.



Montgomery Point Lock and Dam

In October 1986, the Corps began a study of engineering, environmental, and economic factors affecting the White River Entrance Channel in southeastern Arkansas. The first link in the McClellan-Kerr Arkansas River Navigation System, the channel was located in the only part of the system not regulated by a lock and dam. The original planners of the system believed that a dam would be unnecessary at this segment based on 100 years of data indicating that the elevation of the White River at its confluence with the Mississippi had never dropped below 110 feet above sea level. At that elevation, sufficient navigation depths existed. Over time, however, the Mississippi River scoured out the river bed and actually lowered its elevation near the confluence with the White River.[44] Other factors, including construction of revetments and levees upstream, caused additional shoaling at Montgomery Point. During the 1988 drought along the Mississippi River, as sand built up in the lower water stages of the White River, the Corps had to maintain six dredges to keep the channel open.[45] Corps officials did not consider continual dredging a viable option, given that the wetlands and hardwood bottomlands surrounding the site provided only limited disposal areas.[46]

By this time, the Little Rock District was conducting a feasibility study to deal with the low water problem. Part of the study included production of a model at the Corps' Waterways Experiment Station (WES) in Vicksburg, Mississippi. Tests conducted by WES personnel suggested that an additional lock and dam in the entrance channel would relieve navigation problems on the system during times of low water. WES modeling also indicated that other alternatives would not solve the problem.[47]

Upon submission of the feasibility report, SWD personnel presented the findings to Corps headquarters and the Office of the Assistant Secretary of the Army for Civil Works. Assistant Secretary Nancy Dorn, appointed by President George Bush, approved the report. However, she maintained that Montgomery Point Lock and Dam was a new project whose cost should be shared with the Inland Waterways Trust Fund (a fund established under the Water Resources Development Act of 1986 and paid for by fuel taxes levied on barge and tow operators). Congressional proponents of the project argued that the lock and dam were a part of the McClellan-Kerr Navigation System and should be funded by the federal government.[48]

After reviewing supporting data from SWD and Little Rock District, Secretary Dorn changed her position and agreed that Montgomery Point should be considered part of the original McClellan-Kerr project. In November 1991, she requested that the Little Rock District submit a limited reevaluation report to support a construction decision. SWD personnel, under the direction of Division Engineer Colonel James Paul King, formed a team that recommended a design incorporating submersible gates. The design was unprecedented in the United States; no other submersible gates were capable of withstanding flows of over 12 feet above the gates when in a raised position.[49] The district incorporated detailed design features based on division recommendations and further WES modeling. The total cost of the lock and dam, according to the feasibility report submitted in October 1993, would be $200 million. By the end of 1996, however, allocated funds amounted to only $18.6 million for real estate and continuing engineering and design. Real estate acquisitions began in January 1994, using previously appropriated funds.[50] In July 1997, the Little Rock District awarded a $186 million construction contract to J. A. Jones/Guy F. Atkinson, Joint Venture.

Houston Ship Channel

Proposed expansion of the Houston Ship Channel in Texas pitted environmental concerns allied with economic interests dependent on marine life against the economic interests of large-scale commercial navigation. The experience of this



A Corps contract dredge works the Houston Ship Channel in 1988.



Photographs from the 1990s (this and following pages) demonstrate the levels of activity at the Port of Houston, as well as the need for enlargement.



project demonstrates the complexity and diversity of interests that the Corps has had to consider in recent years when planning the enlargement of a major urban waterway.

The Houston Ship Channel extends from the Port of Houston in the northeastern part of that city to Galveston Bay and the Gulf of Mexico. It is the most important industrial deep-draft channel in the Southwest. The Houston-Galveston metropolitan area manufactured more than 50 percent of the nation's petrochemicals, and refineries on the Texas and Louisiana coasts produced 78 percent of the nation's gasoline during the 1980s.[51] By then, the Port of Houston had become the nation's third largest port, and one in five jobs in the Houston area was directly or indirectly associated with the port. The channel was the crucial link between the inland port, the Gulf Intracoastal Waterway, and the Gulf of Mexico.[52]

The first improvements to the 50-mile waterway came in 1905, when the Galveston District straightened sharp bends and built a pile dike. In 1919, the district widened the channel to 30 feet and enlarged the turning basin at the Port of Houston. Various expansion projects took place from the 1920s through the 1940s. In 1958, the Corps deepened segments of the channel to 40 feet.[53]

During the 1960s and 1970s, technological advances changed the deep-draft port requirements. Larger vessels carrying containerized cargo increased the draft requirement of navigation channels. Petroleum "supertankers" drafted well in excess of 40 feet, and some were more than 1,000 feet long and 250 feet wide. As one of the largest petroleum-handling ports in the world, the Port of Houston and its waterways had to be capable of handling the larger vessels. As the port grew, channel users repeatedly advocated enlarging and deepening the Houston Ship Channel. A deeper channel would permit many petroleum tankers to navigate the channel instead of first "off-loading" their product onto smaller tankers to reduce draft. A wider channel would also reduce the incidence of "Texas chicken accidents," which occurred when large vessels attempted to pass each other in the narrow channel.[54] In 1992, for example, the barge *Duvall II*, loaded with molten sulfur, collided with the *Juraj Dalmatinac*, a freighter. Until a salvage company hired by Pennzoil Sulphur, the owner of the barge, cleared the wreckage, the collision permitted only one-way traffic through the channel.[55] In the wake of this incident, shipping experts estimated that a complete channel closure would cost local industries more than $1 million a day.[56]

To increase the volume of commercial navigation traffic through the channel and improve safety, the Corps and local officials developed a two-phase plan to increase the channel size. In 1988, the Galveston District released the Galveston Bay Area Navigation Study (GBANS), whose main feature was to increase the channel to 600 feet at a depth of 50 feet for





the entire length of the 39-mile Houston Ship Channel. In addition, the project would deepen a 1,125-foot section of the Galveston Channel to 50 feet. The Corps estimated construction costs at $457,217,000, of which the federal government would pay $196,864,000. The local cost estimates were $250,673,000.[57]

Phase one of the planned expansion would increase the channel width to 530 feet and depth to 45 feet. Phase two would expand the width to 600 feet and depth to 50 feet. In 1989, SWD, the Galveston District, the Port of Houston, and the EPA released their proposal to increase the width and depth of the Galveston and Houston ship channels.[58]

As plans for enlarging the channel became public, some environmental groups expressed opposition. Groups such as the Galveston Bay Foundation raised concerns that deepening the channel to 50 feet would create a salt water wedge, thereby damaging fisheries and oyster beds and harming the multimillion-dollar seafood industry dependent on the bay. Federal critics, including the U.S. Fish and Wildlife Service, even predicted that increased salinity might destroy 80 percent of Galveston Bay's oyster beds. Critics also opposed the additional dumping of dredged material in the three main sites for dredge deposition (two in the bays and one in a tributary to the channel) arguing that these were environmentally sensitive areas.[59]

When the EPA and the National Marine Fisheries Service joined the U.S. Fish and Wildlife Service in harsh criticism of a plan that the former agency stated "had no regard for environmental amenities," the Corps found its preferred plan in jeopardy.[60] The EPA sharply criticized the project for its potential damage to shrimp populations and the shrimp industry. In response, Assistant Secretary of the Army for Civil Works Robert Page invited representatives from agencies critical of the plan to participate in a cooperative project review to reexamine GBANS and the general public review process.[61] To resolve these and other issues, SWD personnel coordinated discussions among representatives from the Galveston District, U.S. Fish and Wildlife Service, shipping and industry officials, and environmental groups. Collaborating with environmental personnel in headquarters, SWD and Galveston District facilitated a compromise that balanced the economic concerns of navigation and fishing with those of the environment.[62]

In January 1990, Corps headquarters released the chief of engineers' final Houston Ship Channel report. The deepening project would occur in two phases: The first would dredge the channel to a depth of 45 feet and a width of 530 feet. The second stage would complete the dredging to a 50-foot depth and 600-foot width. By the end of 1992, the groups were close to agreeing on a plan for the first phase that would significantly reduce the impact of dredge deposition.[63]

SWD personnel continued to coordinate discussions between representatives from the Galveston District, the U.S.



Traffic on the Gulf Intracoastal Waterway (GIWW) would halt if the remaining strip of land at Sargent Beach (Galveston District) was allowed to continue eroding at a rate of 33 feet per year.

Fish and Wildlife Service, shipping and industry officials, and environmental groups. In its liaison capacity, the division facilitated a compromise that balanced industrial and environmental concerns. As of the end of 1994, the groups had agreed on a cost-sharing formula and a channel depth of 45 feet.[64] Congress authorized construction in 1996; the first contract is to start in 1998.

The Gulf Intracoastal Waterway: Sargent Beach

SWD also supported improvements on the Gulf Intracoastal Waterway (GIWW) in a project that combined shoreline protection and navigation improvements. The waterway extends from the Sabine River south to Brownsville on the Mexican border, a distance of 423 miles. At Sargent Beach in Matagorda County, Texas, the shoreline protects the GIWW from the open waters of the Gulf of Mexico. Engineers at the Galveston District estimated that the beach was eroding at an average rate of over 30 feet per year, and that such erosion would disrupt commercial traffic on the GIWW by the year 2000. By 1991, there was a mere 600-foot-wide stretch of land separating the ocean from the GIWW at Sargent Beach. Owners of coastal industries grew concerned that a breach in the land would disrupt the annual transportation of up to 26 million tons of cargo between Galveston and Corpus Christi. One expert estimated that "if the canal is shut down for more than 20 days, the direct economic impact to refineries forced to close would be at least $80 million."[65] Another estimate concluded that a breach in the waterway would delay transport of 73 million tons of commerce with a value of $21 billion.[66]

The Corps responded by initiating a shore protection project designed to preserve a critical 8.5-mile stretch of Sargent Beach.[67] In 1989, the Galveston District conducted a survey of the GIWW's main channel to identify those areas in need of shoreline maintenance. Erosion at Sargent Beach stood out as a major threat to commerce. By 1992, the division submitted a final report to Congress that recommended construction of an 8-mile-long barrier paralleling the Gulf of Mexico shoreline. The proposed barrier incorporated two elements: a concrete block revetment and a sheet pile wall of reinforced concrete.[68] District Engineer Col. Brink P. Miller reassured commercial interests that the 42,000-foot shore

protection project would "save the GIWW from erosion at Sargent Beach and thereby assure continued use of this vital waterway to Texas industry and waterway users."[69]

Design studies, including physical model tests, began in 1991 at the Corps' Coastal Engineering Research Center. Meanwhile, division personnel under the direction of Brigadier General Stanley G. Genega provided information on the project to local, state, and federal elected officials. The division also coordinated activities with the Corps' headquarters. In March 1992, Governor Ann Richards toured the Sargent Beach area by helicopter and offered to provide the division with "any assistance that the State can give." [70] With support of the state government and the Texas delegation in Congress, the Sargent Beach project was included in the Water Resources Development Act of 1992. Construction of the $75-million wall began in late 1994, with completion projected for 1998.[71] Sargent Beach promises to be a project that protects both economic and environmental interests.

The Gulf Intracoastal Waterway: Aransas National Wildlife Refuge

Keeping the Gulf Intracoastal Waterway open and fully functional was a top priority for the Corps. However, the waterway traverses some of the nation's most sensitive ecological habitats, and environmental concerns accompany operation of the GIWW. As it passes through Aransas and Calhoun counties in Texas, the waterway extends through the southern boundary of the Aransas National Wildlife Reserve. Through the Welder Flats area, the GIWW virtually bisects the habitat of the whooping crane. Whooping cranes, nearing extinction by the 1940s, had since re-established themselves inside the refuge. However, because of wind-generated waves, shipping activity, and dredging practices, the whooping crane habitat was eroding along the waterway. Losses had increased to 2 acres per year by the early 1990s.[72]

The Endangered Species Act of 1973 required federal agencies to "insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat."[73] Because the federally funded waterway was partly responsible for the erosion, the Corps began to investigate ways to lessen its impact on the environment. SWD coordinated extensive studies under the author-



The Corps of Engineers has taken significant steps, such as concrete mesh mats to protect the shoreline (above) and imposing "no wake zone" on ship traffic (following page), to protect the habitat of the whooping crane at Aransas National Wildlife Refuge. The refuge is adjacent to the GIWW.



The Corps of Engineers has imposed "no wake zone" on ship traffic (above), to protect the habitat of the whooping crane at Aransas National Wildlife Refuge. The refuge is adjacent to the GIWW.



ity of Section 216 of the Flood Control Act of 1970, which authorized the review of completed projects whenever changing physical or economic conditions warranted.[74]

Coordination was complex because of the nature of the problem and the environmental and economic interests involved. SWD Planning Division served as liaison in developing alternatives that would keep the waterway fully operational and at the same time protect the whooping crane habitat. Division personnel worked with Galveston District planners on the technical aspects of protection, as well as with other interested federal agencies, such as the U.S. Fish and Wildlife Service, representatives of the Aransas National Wildlife Refuge, and the National Marine Fisheries Service. SWD also worked with the local sponsors and the Texas Parks and Wildlife Department in evaluating potential environmental impacts associated with various alternatives. The interested groups met for general scoping meetings in November 1992, May 1993, and August 1994.[75] Public involvement was a constant part of the planning process; the Corps published notices of each meeting, and held a public scoping meeting in July 1993 at Rockport, Texas.[76]

In June 1995, the Corps completed a draft EIS. The final November 1995 EIS recommended bank erosion protection using articulated concrete mats and grout tubes. The EIS also contained planning for contaminant spill control.[77] SWD continued to serve as liaison as it formed an Interagency Coordination Team to make recommendations for a 50-year plan for the refuge.

Flood Control and Water Supply Activities

In the decades following World War II, rapid growth took place in Texas, Oklahoma, Arkansas, and New Mexico. Cities such as Dallas, Houston, Tulsa, Little Rock, and Albuquerque expanded into formerly rural areas, many of which were located in low-lying floodplains. As residences and businesses located near creeks, rivers, and bayous despite the potential danger, the need for flood protection grew dramatically. Local flood control agencies built some small flood control works, but larger projects required federal participation. Once the water resources funding impasse ended with passage of WRDA-86, the activities of many of the Corps' divisions increased and diversified. In performing its functions of quality assurance, program management, oversight, and liaison, SWD provided a variety of technical, procedural, and coordinating activities for flood control projects throughout the area of operations.

Mingo Creek

Mingo Creek is a tributary of the Arkansas River that drains much of eastern Tulsa, Oklahoma. As the city grew in the 1950s and 1960s, many people built homes along the Mingo Creek floodplain. Periodically the creek overtopped its banks, with damages rising from each successive flood. Ten major floods occurred along Mingo Creek between 1959 and 1988, an average of one every two to three years. In May 1984, a record flood resulted in five deaths and $124 million in damages.[78]

Following the 1984 storm, local efforts to prevent flooding along Mingo Creek intensified. The Tulsa District had developed plans for Mingo Creek flood control during the 1970s and early 1980s. Plans called for a straight channelization of the stream as the most efficient means of controlling flooding. However, during public meetings regarding the project, residents objected to the proposed concrete channel as not being aesthetically pleasing, even though it provided the greatest flood protection for each dollar spent.[79]

Engineers at the Tulsa District responded by developing alternative plans that incorporated about 9.4 miles of channelization and 23 flood water detention sites. The detention sites were small flood control reservoirs that would retain water during a flood and then release it gradually when the flood had receded. These sites would also have recreational use as picnic and day-use areas. District personnel took their new plans to SWD planners and gained quick endorsement. The division, in turn, sought and secured approval for the idea from the headquarters planning division. By 1985, the Corps had completed the modified plans. The completed project would provide a minimum of 65-year protection in the major flooding area.[80]

A second obstacle to flood control on Mingo Creek was funding. The long water resources funding impasse in Congress continued from the Carter administration into the Reagan administration. However, WRDA-86 provided authorization for Mingo Creek, also requiring cost-sharing agreements between the federal government and local sponsors. Non-federal participation substantially increased because of Congress's intent to eliminate projects with marginal local interest.[81]

The constant flooding problems and memories of the disastrous 1984 storm compelled residents of the Mingo Creek



Two of the 23 detention sites which, along with 9 miles of channelization, make up the Mingo Creek Local Flood Protection Project in Tulsa, Oklahoma. The project was among the first in the nation under the provisions of the Water Resources Act of 1986 (WRDA-86).

floodplain to urge adequate local support for the project. With the support of the Tulsa District and SWD, local and federal officials signed a cost-sharing agreement in January 1988. This agreement was one of the first under the cost-sharing provisions of WRDA-86. In a ceremony at the Tulsa City Hall, Assistant Secretary of the Army for Civil Works Robert Page and Tulsa Mayor Dick Crawford signed an agreement by which the federal government would provide approximately $96.6 million and non-federal interests would provide $58.5 million to complete the project. WRDA-86 stipulated that non-federal interests provide land, easements, rights of way, and dredged material disposal areas; oversee modification or relocation of buildings, utilities, roads, bridges, and other facilities during construction; pay five percent of the costs allocated to flood control; and bear all costs of operation, maintenance, and replacement of flood control facilities. The city of Tulsa agreed to these measures in the 1988 agreement.[82]

When construction began in September 1988, the city of Tulsa had already completed 4.75 miles of channel and placed two detention basins in operation. Construction of the Mingo Creek project continued into the early 1990s, and was approximately 45 percent complete at the end of 1993.[83] In February 1994, the Corps named one of the detention sites after Larry H. Redford, the Tulsa District employee who had been instrumental in maintaining progress and good relations throughout the Mingo Creek project and who died in 1993.[84] By this time, the National Society of Professional Engineers had named two of the detention sites in its top ten list of innovative projects. In the words of the society, the innovations transformed a potentially "effective but unsightly flood control project into a community asset with multiple uses and benefits."[85]

Sims Bayou

Sims Bayou is one of the tributaries of Buffalo Bayou, the primary drainage of the Houston metropolitan area. Sims Bayou flows through southern Harris County into Buffalo Bayou near Pasadena, Texas, east of Houston. During the 1940s and 1950s, as the Houston metropolitan area grew rapidly, many people built homes and businesses in the Buffalo Bayou watershed. Sims Bayou was particularly prone to flooding. Consequently, during the late 1970s the Galveston District began to study flood protection along the bayou.



Sims Bayou, site of a Galveston District flood control project with Harris County Flood Control District as a local sponsor, will provide protection for a large area of metropolitan Houston, Teaxs.



In 1983, the Galveston District issued a final report and environmental impact statement for a 19.3-mile run of Sims Bayou. The district's recommended plan called for 50-year storm protection, but the Corps' Board of Engineers for Rivers and Harbors argued that a plan for 25-year protection had the greater benefit/cost ratio.[86] In October 1990, the Harris County Flood Control District (the local sponsor) signed a Local Cooperation Agreement with the Corps in accordance with the provisions of WRDA-86. The project called for 25-year flood protection along 19.3 miles of the bayou, at a federal cost of $191.5 million and a non-federal cost of $86.8 million.[87]

Working with the Harris County Flood Control District, the Galveston District developed plans that called for channelization using concrete lining and cellular concrete mats. As the plans became public, many local residents and environmental groups expressed opposition to the plan that would clear trees and foliage in construction of the concrete channel. Congressman Michael Andrews, whose district included the project area, led local residents in forming organizations to persuade the Corps and Harris County to alter the original plans.[88] With construction ready to begin, changes would be difficult. However, in the wake of the cost-sharing provisions of WRDA-86, local sponsors could influence projects more than before.

As it did for residents living along Mingo Creek in Tulsa, the Corps listened to the concerns of Sims Bayou residents. SWD personnel under the leadership of Brigadier General Robert Herndon (division engineer 1992-1993) attempted to keep the project on schedule by bringing all interested parties together to work out solutions. During 1992, SWD served as liaison in meetings with Congressman Andrews, Harris County officials, the Galveston District, the Sims Bayou Coalition (a local residents' group), environmental organizations, and the architect-engineering firm working on the project. The solution the groups reached provided for a flood control project outlined largely in the Corps' "Modified Channel Plan." The modified project was more environmentally and aesthetically acceptable to local residents. The plan replaced concrete linings along the channel with additional cellular concrete mats that allowed the growth of vegetation. The plan also included an adjacent park, to be landscaped with trees donated by a local supermarket chain and completed with 27 miles of hiking and biking trails that would connect to existing public parks. Other environmental enhancements included in-channel fish ponds and planting of native grasses.[89] Corps officials concluded that the alterations would be 95 percent as effective in flood prevention as the original plan, and the changes could occur without significant construction delays or increased costs.[90]

In late 1991, while Harris County deliberated on approval of the changes, the Corps initiated a value engineering study on the Sims Bayou. Galveston District personnel invited a Harris County flood control official to join the value engineering team. The team explored still more changes that could result in significant savings from the original estimated cost of $315 million. The most significant change used new technology to replace concrete. Instead of the perforated concrete, construction would include geotextile mats, as well as additional use of native grasses.[91]

The Acequias Irrigation System

"Acequia" is a Spanish term for "irrigation canal." After settling in New Mexico around Santa Fe during the 1600s, Spanish colonists began building acequias modeled after those found in Europe, but also expanded and connected them to those built by the Pueblo Indians of the region. The acequias provided irrigation and potable water to the arid land. The acequias were constructed from a variety of materials, including rock, brush, and adobe. Over the next two centuries, Spanish, Mexican, and Indian inhabitants of New Mexico expanded the acequias system until there were more than 1,000 of the structures. New Mexico residents continue to use the acequias; in fact, their cooperative use by acequias associations, Indian reservations, and farmers' organizations is one of the distinctive characteristics of New Mexico's culture.[92]

Because of the age and composition of the acequias, some had become unreliable by the mid-1900s. Sudden thunderstorms or heavy spring rains frequently damaged or destroyed the diversion works of many acequias. At the same time, the growing population of New Mexico increased demand for water from the acequias system. Federal support for rehabilitation and restoration of some acequias began in the 1970s, but was not implemented until passage of WRDA-86. Local residents and Albuquerque District representatives argued strongly before congressional committees for restoring the acequias.[93] The state government also demonstrated its commitment. In 1986, WRDA directed the Corps to undertake restoration measures for certain acequias "without regard to economic analysis."[94] In the resulting cost-sharing agreements, the State of New Mexico was to provide 17.5 percent of the total cost. The state also committed an additional 7.5 percent in low-interest loans to local acequias associations.[95] The federal government supplied the remainder of funds for the $63.9-million renovation project.[96]

Following authorization, Albuquerque District personnel held public meetings and worked closely with acequias associations to ensure that the renovation project responded to the needs of New Mexico farmers. According to Mark Andrews, project manager from the Albuquerque District, renovation "includes anything from replacing a slidegate on a



The dedication ceremony for the first acequia restoration project (Cinco Acequias) in 1989. Officiating at the ceremony, from left to right (foreground), Congressman Bill Richardson, Senator Pete Domenici, New Mexico State Engineer Steve Reynolds, and Albuquerque District Commander, Lieutenant Colonel Kent Gonser.

headworks to building a major diversion dam."[97] The district contacted 600 acequias associations and received 300 requests for help. From this group, 20 of the acequias "with the worst problems and serving the greatest number of people were given the highest priority."[98] In 1989, the Corps completed the first phase, "Cinco Acequias," which focused on the repair of five channels on both sides of the Santa Cruz River. These acequias supplied water to 990 acres of land in the Santa Cruz valley, benefiting over 600 landowners.[99]

During the course of this restoration, the Corps corrected sedimentation problems associated with a dam built in 1970. The diversion dam served the five channels but, by the 1980s, sediment had blocked north side water deliveries. In 1989, the Albuquerque District completed a diversion dam 75 feet upstream that significantly increased irrigation flow to each channel.[100] In June 1992, the Corps signed a long-term local cooperation agreement with the State of New Mexico, which acted on behalf of each individual acequias association. By the end of 1994, the agency had completed 30 acequia projects, was in the process of constructing three others, and was designing six more.[101]

The acequias project represented a new approach for the Corps. Restoration of irrigation systems, some more than 200 years old, runs counter to the agency's history of designing the most efficient and modern civil engineering systems. However, the Corps recognized that the local interest in restoring and repairing an old system reflected cultural as well as economic needs. The acequias project is an example of a Corps district and division carefully listening to public desires to maintain the historical and cultural integrity of an irrigation system. Working together to interpret federal law properly, district and division personnel used their lines of communications with Corps headquarters and the Office of the Assistant Secretary of the Army for Civil Works to develop a workable and rational plan for the acequias restoration.

Red River Basin Chloride Control Project

Two of the principal river basins of SWD have extraordinarily high levels of salt in their waters. Both the Arkansas and Red river basins flow through land on which an ancient inland sea existed during the Permian Age (220-270 million

years ago). The sea, located in the high, southern Great Plains, included the present Texas and Oklahoma panhandles and parts of eastern New Mexico and southwestern Kansas. After being isolated in the late Permian Age, the sea eventually evaporated. Rock and silt eventually covered the dry sea bed, but the salt remained beneath. Underground springs, pressured by the Rocky Mountains, flow through the salt deposits, creating brine. The brine eventually makes its way to the surface and flows into the tributaries of the Arkansas and Red rivers.[102]

The high salt content in these rivers has posed significant problems to residents of Texas, Oklahoma, Kansas, Arkansas, and Louisiana. The salinity has compromised water supplies for agricultural, municipal, and industrial uses. In 1957, U.S. Public Health Service officials began a comprehensive study of water quality in the Red River basin. They learned that a daily average of 3,600 tons of salt was leaching into the river. Five natural salt sources in northwestern Oklahoma and southwestern Kansas also contributed to the salinity of the Arkansas River. The health service study similarly found ten sites in northwestern Texas and southwestern Oklahoma contaminating the Red River basin.[103]

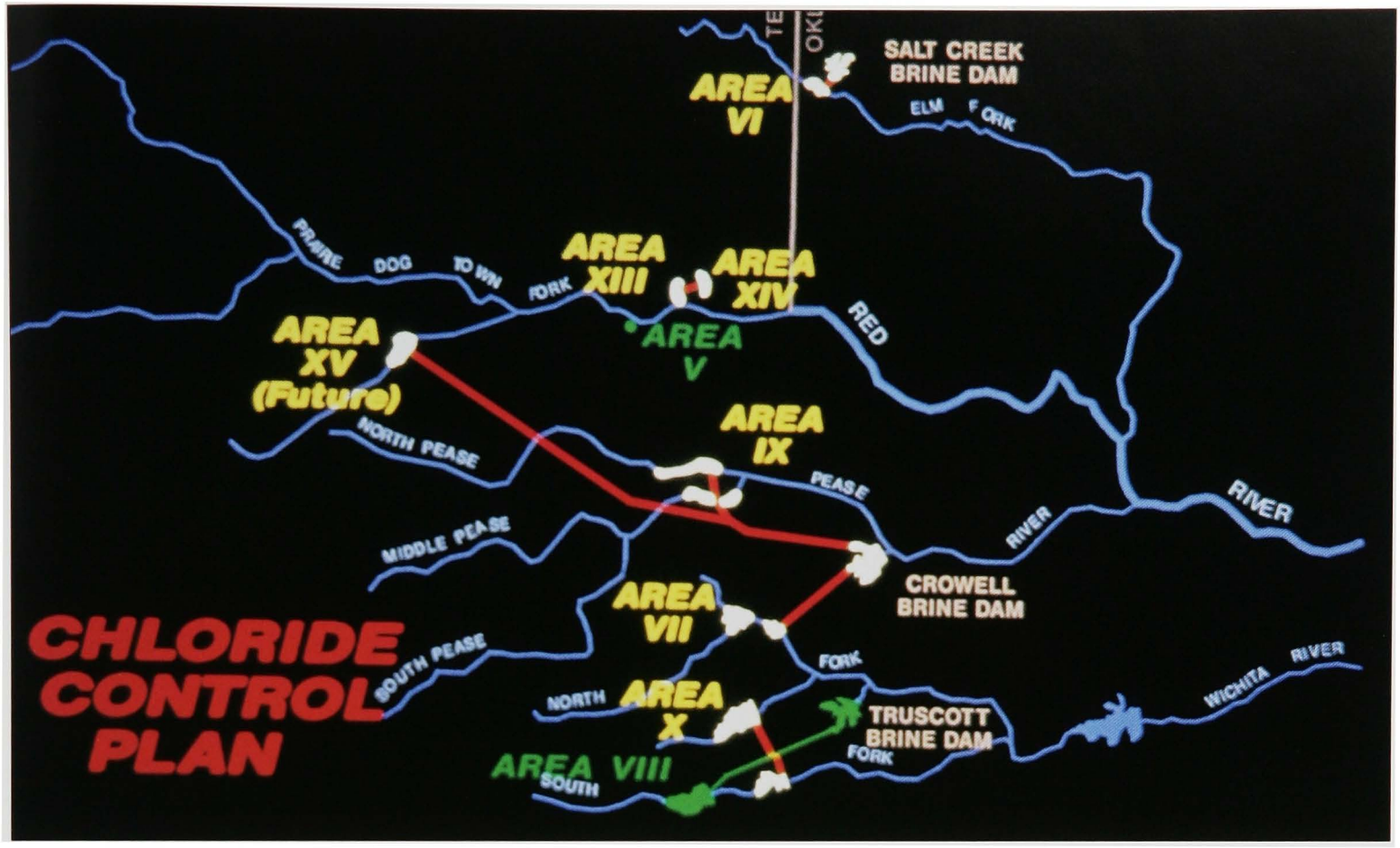
The Red River contamination caused more severe salinity than in the Arkansas River. At Lake Kemp on the Wichita River, the water met EPA standards for dissolved salts in municipal water supplies 0 percent of the time; at Lake Texoma, only three percent of the time; and as far east as Shreveport, Louisiana, only 88 percent of the time. To improve the quality of Red River water, Congress authorized in the Flood Control Acts of 1962, 1966, and 1970 structural measures for controlling the flow of brine from eight of ten sites near the Red River.[104]

SWD delegated the construction work to the Tulsa District. The first phases of the Chloride Control Project included construction and subsequent maintenance of wells and ring dikes for data collection. In 1963, the Corps built an earthen dike nine feet high and 340 feet in diameter surrounding the salt water source at Estelline Springs, Texas. Since the completion of the dike in 1964, the flow of brine from Estelline Springs has ended, and the salt contribution from the area has been reduced by 80 percent. At a second site about 60 miles west of Wichita Falls, Texas, the Corps began construction in 1976 of a system to capture brine that contributed almost 195 tons of salt daily to the Red River. A low-flow inflatable rubber dam captured 84 percent of the brine, which was then pumped 23 miles away to the newly constructed Truscott Brine Lake. The Corps completed this phase of the project in 1987. The Truscott Brine Lake contains no outlet works; its level remains constant through evaporation.[105]

The Water Resources Development Act of 1986 expanded the Corps' efforts to reduce chloride in the water of the Red River basin. The act authorized the Red and Arkansas River basins as separate projects.[106] The legislation also



Truscott Brine Lake in the Texas Panhandle completed by the Tulsa District in 1987.



The overall Chloride Control Plan (as of 1990).



Bateman Pumping Station on the South Fork of the Wichita River is typical of the facilities that reduce the chloride levels of the Red and Arkansas Rivers and their tributaries.

exempted the Red River chloride project from cost-sharing provisions, pending an independent evaluation of the effectiveness of Truscott Brine Lake system. A five-member team, chaired by engineering professor Jack Keller of Utah State University, declared in 1988 that the system was even more effective than Corps estimates. The panel recommended to Congress that construction continue on the project.[107] Ongoing construction includes one deep-well injection system, two additional brine storage reservoirs, three additional low-flow dams, two well collection facilities, six pumping plants, and 56.3 miles of pipeline.[108] With each completed phase of the overall $192.6 million project, the water flowing into the Red River improved, significantly augmenting the water supplies of municipalities in Texas, Oklahoma, and Louisiana.

Cochiti Wetfields

The Pueblo de Cochiti wetfields are immediately downstream from the Cochiti Dam and Reservoir in north central New Mexico, approximately 50 miles north of Albuquerque. After the Corps built Cochiti Dam on the Rio Grande River, seepage under the structure began in 1976. The seepage increased over time, and caused damage to the agricultural lands of the Pueblo de Cochiti. From 1988 to 1991, the Albuquerque District worked with the Pueblo de Cochiti Indians to identify the magnitude of the seepage problem and develop an engineering solution to "return the Pueblo lands to their traditional agricultural and cultural use."[109] The three-year study yielded a plan to construct a $4.2 million underground drainage system on approximately 625 acres of agricultural land. The Corps spent $9.7 million on operation and maintenance and settlement of past damages. The Albuquerque District completed the project in September 1994 at a total cost of $13.9 million.[110]

The Cochiti wetfield project was unique for the Corps primarily because of the number of groups involved. The division coordinated negotiations among the Cochiti tribe, the Bureau of Indian Affairs, the State of New Mexico, and the Albuquerque District. The ultimate objective for all parties concerned was the restoration of the lands to their original condition.[111]



The Cochiti Wetfields before (above) and after (top right) restoration by the Albuquerque District.



Recreation

Recreational use of Corps water projects is a significant component of the civil works mission. This is especially true in SWD, where large numbers of people use Corps lakes for boating, waterskiing, fishing, and swimming. Nationwide, the Corps operates 650 campgrounds in 43 states, second only to the number operated by the U.S. Forest Service.[112] The Corps is also the nation's largest provider of water-based recreational facilities. In 1990, the Corps recorded more than 2.3 billion visitor hours at its 460 lakes and reservoirs, and served an estimated 25 million people.

For some Corps divisions, management of recreational sites is minimal. For SWD, however, recreation is an important and vexing challenge. Since the early 1980s, the division has experienced the greatest percentage increase nationwide in use of Corps recreational facilities. In 1981, SWD had 32 percent of the agency's total recreational use. By 1995, that number had increased to 40 percent.[113]

In 1988, Bill Kitchen, a professor of park administration from Texas Tech University, spent the summer at Greer's Ferry Lake evaluating the Corps' recreation program. In statements to the news media, he cited the high quality of the Corps parks and praised the Corps rangers as more customer-oriented than National Park Service (NPS) rangers. (The high quality of the Corps rangers resulted in part from a rigorous training program conducted by personnel of SWD headquarters.[114]) Because Corps parks record more visitor hours than NPS parks, Kitchen concluded that the Corps "needs more public recognition of its role."

Heavy recreational use in SWD has presented many safety challenges, including boating, swimming, skin diving, hiking, and camping-related concerns.[115] Because of the increasing recreational use, safety became a major Corps concern. In 1986, the Corps initiated a program to promote water safety at its facilities. Together with the Centers for Disease Control, the Corps reviewed information about drownings and water safety programs, and promoted a program called "Your Safety, Our Concern." Radio and television broadcasts, educational posters, and permanent information and advisory posters at each Corps recreational facility supported the program.

During the late 1980s and early 1990s, an increasing disparity between operational costs and revenues prompted the Corps to reassess its role as a recreation provider.[116] The 1990 annual budget for operation of Corps recreational facilities totaled $160 million. Because the Corps did not charge admission at most of its facilities for day-use activities

such as hiking, boating, fishing, bicycling, or bird-watching, revenues were less than they might have been. Total recreational revenue in 1989 was $16 million, all of which came from camping fees.

In 1990, the Corps initiated a National Recreation Study to find ways to "maintain and enhance the quality of recreational opportunities at our reservoirs and cut the Federal cost."[117] The National Recreation Study, conducted by the Corps' Institute for Water Resources, explored various methods of improved management at lower federal cost.[118] One alternative explored in the study was privatization, a plan the Corps attempted to implement in some areas.[119] SWD, which maintains 98 lakes in its area of operation and 180 parks in Arkansas alone, became one of the test divisions. In 1993, the division transferred the Arkansas Highway 27 Recreation Area in Montgomery County to a private operator, and shortly thereafter leased two additional sites (Howard Cove on Norfork Lake in Baxter County and a facility on Lake DeGray) to private operators.[120]

The experiment had several ramifications. Many visitors were skeptical about privatization, fearing that it would



The Southwestern Division's recreational facilities are the most heavily used in the nation. Fishing in Texas, windsurfing in Oklahoma, power boating the navigation system in Arkansas, and sail boating in Texas illustrate the diversity of recreational use as well as the challenges for Corps management.




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force them to pay higher fees at the campgrounds, launching ramps, and entrance gates in these now for-profit parks. The Corps attempted to lessen their fears by requiring that all private operators acquire Corps approval of prices charged for gasoline, food, and meals at restaurants. The Corps would also regulate fees and vendor prices.[121] Despite the Corps' efforts, however, elderly visitors to the privatized Arkansas Highway 27 Recreation Area had to pay twice as much, because their 50 percent discount at government-operated parks no longer applied. After four years of experimentation, evidence of the effectiveness of privatization remained inconclusive.

Another management alternative proposed in the National Recreation Study was to invite state governments to become involved in managing Corps recreational facilities. Of the five states approached to participate, only Kansas volunteered. Under the agreement, the state would receive a lump-sum payment of $35 million from the Corps in a trust that user fees would augment. Interest from the trust fund would provide money for maintenance of the facilities. The Corps would retain ownership of the land and lease it to the state on a long-term basis. Nonparticipation in the pilot program did not preclude other states from assuming control of select Corps parks. In Arkansas, for example, Murray Park in Little Rock and DeGray Park near Arkadelphia were turned over to the State of Arkansas.[122]

Recreation continues to be a major part of the public service of SWD. As the Corps budget for operating recreational facilities declines, demand for the division's facilities increases. Maintaining quality recreational facilities under such circumstances remains a great challenge to SWD personnel.



Civil works activities during the late 1980s and the early 1990s reflected both change and tradition for SWD. Change was most evident in the provisions of WRDA-86, which significantly altered the course of the Corps' civil works projects. With increased cost-sharing, Corps personnel had to adjust to a greater number of influences over Corps projects. In particular, local sponsors exercised more influence over the planning process. The trend toward greater public participation in shaping water projects also continued. Environmental concerns challenged the agency to meet a diverse number of public demands. Each of these factors influenced the role of divisions and districts. Increasingly, division personnel were compelled to serve as mediators in resolving difficulties or tensions associated with civil works projects. External tensions could include conflicts with other federal agencies, the public, state and local governments, or Congress. Internal tensions involved problems at the district level, in the Office of the Assistant Secretary of the Army for Civil Works, or in Corps headquarters. In addition to the traditional support of oversight and analysis between districts and headquarters, SWD personnel adapted to meet the new legislative and administrative challenges in the post-WRDA-86 world of civil works activities.

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[1] Fact Sheet, O&M Expenditures, 1986-1995, SWD historical files.

[2] See D. Clayton Brown, *The Southwestern Division: 50 Years of Service* (Dallas, TX: U.S. Army Corps of Engineers, 1987), Chapter VII, for a discussion of the Trinity River waterway.

[3] Bill Sloan, *Gift of Water, Legacy of Service: A History of the North Texas Municipal Water District* (Dallas, TX: Taylor Publishing Company, 1994), p. 1.

[4] Judy Marsicano, "Finally . . . Cooper Lake!" *Dispatch* vol. 10, no. 1 (January 1992), pp. 6-8.

[5] *Annual Report of the Secretary of the Army on Civil Works Activities, 1993*, p. 30-5; Interview, Gregory Graves with Tom Knox, Programs Management Division, SWD, 30 October 1995 (telephone).

[6] The Institute for Water Resources was established in 1969 to help the Corps respond to increasing criticism of its civil works program. Regarding the Corps' public involvement see U.S. Army Engineer Institute for Water Resources, *Public Involvement Techniques: A Reader of Ten Years of Experience at the Institute for Water Resources* (IWR Report 82-R1), May 1983.

[7] See Martin Reuss, *Shaping Environmental Awareness: The United States Army Corps of Engineers Environmental Advisory Board* (Washington, DC: Historical Division, Office of the Chief of Engineers, 1987), for a discussion of the Corps' response to NEPA; U.S. Army Engineer Institute for Water Resources, *Environmental Guidelines for the Civil Works Program of the Corps of Engineers* (IWR Report 70-5), December 1970.

[8] Serge Taylor, *Making Bureaucracies Think: The Environmental Impact Statement of Administrative Reform* (Stanford, CA: Stanford University Press, 1984), passim.

[9] *Annual Report of the Secretary of the Army on Civil Works Activities*, 1993, p. 30-5.

[10] Kent Slakey, "The Lake Takes Shape," *Dispatch* vol. 6, no. 7 (July 1988), pp. 8-9.

[11] Ray Sasser, "Cooper Last of Corps' Kind," *Dallas Morning News* (8 November 1992), p. 24B; Interview, Lynn Alperin with Brig. Gen. Stanley G. Genega, 23 September 1992 and 26 March 1993, Washington, D.C. Hereinafter cited as the Genega interview.

[12] Ray Sasser, "Rains Fill Lake Cooper Well Ahead of Schedule," *Dallas Morning News* (5 January 1993), p. 24B.

[13] Brown, *The Southwestern Division*, pp. 52-53.

[14] Ibid., pp. 119(120.

[15] The original name of the reservoir was Lakeview Reservoir, but it was renamed for Texas Congressman Joe Pool, who championed water resources development in the Trinity River Basin, and helped obtain the necessary authorization and appropriations for the project. See *Fort Worth Star Telegram* (30 September 1992).

[16] *Annual Report of the Chief of Engineers on Civil Works Activities*, 1993, p. 30-6.

[17] Joe Pool Lake Fact Sheet, 5 November 1987, SWD historical files.

[18] *Annual Report of the Secretary of the Army on Civil Works Activities*, 1993, p. 30-36.

[19] Joe Pool Lake Fact Sheet.

[20] Ibid.

[21] Originally known as Aubrey Reservoir, it was renamed in honor of Congressman Herbert Ray Roberts. As chair of the House Subcommittee on Public Works, Water Resources, and Transportation, Roberts strongly supported Aubrey Reservoir. See *Dallas Times Herald* (15 April 1990).

[22] *Annual Report of the Chief of Engineers on Civil Works Activities*, 1993, p. 30-8.

[23] Ibid.

[24] Ray Roberts Fact Sheets, 5 November 1987 and 8 November 1987, SWD historical files.

[25] *Annual Report of the Chief of Engineers on Civil Works Activities*, 1993, p. 30-8.

[26] Genega interview.

[27] Ray Roberts Fact Sheets; Interview, Greg Graves with Barry Rought, SWD, 16 January 1995. Hereafter cited as Rought interview; Greg Graves interview with Bill Johnson, SWD Program Management Division, 26 March 1997 (telephone). Hereafter cited as Johnson interview.

[28] Ann Patton, *Fifty Years Remembered: The First Fifty Years of the Tulsa District, U.S. Army Corps of Engineers* (Washington, DC: U.S. Government Printing Office, 1989), p. 192.

[29] *Annual Report of the Secretary of the Army on Civil Works Activities*, 1988, pp. 29-2–29-3.

[30] Interview, Lynn Alperin with Maj. Gen. Jerome P. Hilmes, Dallas, Texas, Jan. 1988. Hereafter cited as Hilmes interview.

[31] Genega interview.

[32] See *United States v. City of Edmond and the Edmond Public Works Authority,* CIV-89-1507-A in the Western District Court, Western District of Oklahoma; Interview, Gregory Graves with Patrick Evermon, SWD Engineering Division, 27 Nov. 1995 (telephone). Hereafter cited as Evermon interview.

[33] Rought interview; *Annual Report of the Secretary of the Army on Civil Works Activities,* 1993, p. 29-3.

[34] Bonnie B. Pendergrass and Lee F. Pendergrass, *In the Era of Limits: A Galveston District History Update, 1976-1986* (Galveston, TX: U.S. Army Corps of Engineers, 1990), p. 24.

[35] See Brown, *The Southwestern Division,* pp. 115-120, for a discussion of Wallisville in conjunction with the Trinity River Waterway; *Annual Report of the Secretary of the Army on Civil Works Activities,* 1993, pp. 31-9.

[36] Brown, *The Southwestern Division,* p. 119.

[37] Rought interview; Hilmes interview.

[38] Ibid.; Pendergrass and Pendergrass, *In the Era of Limits,* pp. 17-18.

[39] *Annual Report of the Secretary of the Army on Civil Works Activities,* 1992, p. 31-9.

[40] Harold Scarlett, "Corps Waiting for Funding OK on Wallisville," *Houston Post* (22 February 1990), p. IA; Bill Dawson and John Williams, "5 Council Members Withdraw Support as Debate Grows on Wallisville Dam," *Houston Chronicle* (22 February 1990), p. 1A.

[41] Pendergrass and Pendergrass, *In the Era of Limits,* p. 36.

[42] "Officials Make One-Site Tour Of Wallisville Lake Project," *The Vindicator* (19 May 1993); Johnson interview.

[43] *Annual Report of the Secretary of the Army on Civil Works Activities,* 1992, p. 31-10.

[44] Johnson interview.

[45] Issue Paper, Montgomery Point Lock and Dam, McClellan-Kerr Arkansas River Navigation System, 14 February 1995; Genega interview.

[46] Interview, Ray Russo, SWD, with Gregory Graves, 31 October 1995 (telephone). Hereafter cited as Russo interview; S. Charles Bolton, *25 Years Later: A History of the McClellan-Kerr Arkansas River Navigation System in Arkansas* (Little Rock, AR: U.S. Army Corps of Engineers, Little Rock District, 1995), pp. 48-50.

[47] Ibid.; *Annual Report of the Secretary of the Army on Civil Works Activities,* 1993, pp. 28-4-28-5.

[48] Ibid.; Rought interview.

[49] Russo interview.

[50] Ibid.; *Annual Report of the Secretary of the Army on Civil Works Activities,* 1993, p. 28-5; Issue Paper, Montgomery Point, 14 February 1995; Appropriation Title Sheet, McClellan-Kerr Arkansas River Navigation System, Locks and Dams, AR and OK, 22 June 1995.

[51] Issue Paper, 22 June 1995.

[52] *Houston Post,* 26 July 1993.

[53] *Annual Report of the Secretary of the Army on Civil Works Activities,* 1980, p. 15-6; *Annual Report of the Secretary of the Army on Civil Works Activities,* 1986, p. 15-26.

[54] Rought interview; *Daily News,* 24 December 1992; *The Waterways Journal,* 11 January 1993.

[55] *Daily News,* 24 December 1992.

[56] *Houston Chronicle*, 24 December 1992.

[57] Ken Bonham, "Houston-Galveston Ship Channel Draft Report Released by Chief: Agency Review Underway," *The Sand Castle* vol. 7, no. 8 (August 1989), p. 3.

[58] Ibid.

[59] U.S. Army Corps of Engineers, Galveston District, *Galveston Bay Area Navigation Study*, 1988, passim; Memorandum for Commander, Southwestern Division, 7 May 1991, SWD historical files; Houston Post, 11 January 1986.

[60] Letter, Robert E. Layton, Jr., EPA, to Lt. Gen. H.J. Hatch, subj: GBANS, 27 October 1988, SWD historical files.

[61] Letter, Page to Jennifer Wilson, NOAA, subj: GBANS, 8 February 1990, Headquarters history 1988(1992 files; Donald Fitzgerald interview with Harry E. Kitch, 19 October 1995.

[62] Rought interview.

[63] *Annual Report of the Secretary of the Army on Civil Works Activities*, FY 1993, p. 31-7.

[64] Rought interview.

[65] Sharon Toth, "Group Fears Sea Wall Plan Is Too Slow," *Dallas Morning News* (8 September 1991), p. 45A.

[66] Tim Delaney, "Sargent Beach Work Could Be Completed Sooner than Planned," *The Victoria Advocate* (17 October 1992); Genega interview.

[67] William R. Pearson, Memorandum for CDRUSACE (CECW-PC) Washington, D.C., 19 June 1991, SWD historical files.

[68] John G. Moravec to Ann Richards, 18 February 1992, SWD historical files; Hilmes interview.

[69] Ken Bonham, "Sargent Beach 'Fix' Proposed by Engineers," *The Sand Castle* vol. 11, no. 8 (October 1991), p. 1.

[70] "Sargent Beach in the Spotlight," *The Sand Castle* vol. 10, no. 3 (April 1992), p. 22.

[71] Ibid.

[72] "Preconstruction Engineering and Design Activities, Aransas National Wildlife Refuge," 6 February 1995, SWD historical files.

[73] "Division Engineer's Public Notice for the Gulf Intracoastal Waterway Aransas National Wildlife Refuge: Final Feasibility Report and Environmental Impact Statement," 3 November 1995, SWD historical files.

[74] Ibid.

[75] Ibid.; "Preconstruction Engineering and Design Activities, Aransas National Wildlife Refuge."

[76] Ibid.

[77] Ibid.

[78] U.S. Army Corps of Engineers, Tulsa District, *Tulsa District Record*, vol. 10, no. 1 (January/February 1988).

[79] Water Resources Development Act of 1986, P.L. 99-662, p. 4123.

[80] Rought interview; U.S. Army Corps of Engineers, *Annual Report of the Secretary of the Army on Civil Works Activities*, 1991, p. 29-7.

[81] Water Resources Development Act of 1986, P.L. 99-662, pp. 4082-4083, 4123; see Martin Reuss, *Reshaping National Water Politics: The Water Resources Development Act of 1986* (IWR Policy Study 91-PS-1), October 1991 for cost-sharing formulas and interpretations of their impact.

[82] *Tulsa District Record*, vol. 10, no. 1 (January/February 1988); *Annual Report of the Secretary of the Army on Civil Works Activities*, 1993, p. 29-8.

[83] Ibid.

[84] Larry Redford, whose father, John, of SWD has 60 years of service with the Corps, was instrumental in maintaining progress and good relations among all interests in the Mingo Creek project. *Pacesetter,* vol. 19, no. 3 (March 1994). p.9.

[85] Quoted in Ibid.

[86] *Houston Post* (22 October 1983).

[87] See Reuss, *Reshaping National Water Politics* for an analysis of the passage of WRDA-86; *Houston Chronicle* (30 August 1992); *Annual Report of the Secretary of the Army on Civil Works Activities,* 1993, p. 31-15.

[88] *Houston Chronicle* (30 August 1992).

[89] Interview, Gregory Graves with David Barber, SWD Engineering Division, 6 Dec. 1995 (telephone).

[90] Ibid; *Houston Post* (27 August, 20 September 1992); *Annual Report of the Secretary of the Army on Civil Works Activities,* 1993, p. 31-15.

[91] Vinod Patel, "VE Teams Save $57 Million on Sims Bayou Project," *The Sand Castle* vol. 11, no. 7 (July 1993), pp. 3-4.

[92] Fact Sheet, Acequias Irrigation System, New Mexico, by Joseph A. Horvath, Albuquerque District, 26 July 1995; "The 20th-Century Engineering Skills on an Albuquerque District Project Return Life to an Ancient Spanish System, *Pacesetter* vol. 14, no. 7 (July 1989), p. 4.

[93] "The 20th-Century Engineering Skills," p. 4.

[94] Water Resources Development Act of 1986, P.L. 99-662, p. 4232.

[95] *Annual Report of the Secretary of the Army on Civil Works Activities,* FY 1990, p. 32-1.

[96] Fact Sheet, Acequias Irrigation System, New Mexico, 26 July 1995, prepared by James A Horvath.

[97] "Acequia Renovation Preserves New Mexico Heritage," *Rip Rap* vol. 11, no. 1 (January/February 1988) pp. 1-3.

[98] Ibid., p. 3.

[99] "Dedication Marks Acequias Renovation Progress," *Rip Rap,* vol. 3, no. 4 (May/June 1989), pp. 1-2.

[100] Ibid.

[101] Fact Sheet, Acequias Irrigation System, New Mexico, 26 July 1995.

[102] U.S. Army Corps of Engineers, Tulsa District, "Red River Basin Chloride Control Project" (pamphlet), 1993.

[103] Ibid.

[104] Ibid.

[105] Ibid.; *Annual Report of the Secretary of the Army on Civil Works Activities,* 1993, p. 29-22.

[106] *Annual Report of the Secretary of the Army on Civil Works Activities,* 1991, p. 29-3.

[107] Patton, Fifty Years Remembered, p. 195; Hilmes interview.

[108] *Annual Report of the Secretary of the Army on Civil Works Activities,* 1991, p. 29-3.

[109] *Annual Report of the Secretary of the Army on Civil Works Activities,* 1992, p. 32-2; Report by Peter K. Doles, Project Engineer, Albuquerque District, 25 January 1995.

[110] Ibid.

[111] Russo interview; Hilmes interview.

[112] Herbert C. Burkholz, "Camping with the Corps," *Trailer Life* (August 1992), p. 85.

[113] "Recreational Use Table," Southwestern Division, 27 February 1996, SWD historical files.

[114] Interview, authors with Linda Noland, SWD, 12 October 1994.

[115] "Recreational Use Table," SWD, 27 February 1996, SWD historical files.

[116] *Dallas Times-Herald* (4 April 1990).

[117] *Arkansas Democrat Gazette* (6 July 1993).

[118] See Gregory Graves, *Pursuing Excellence in Water Planning and Policy Analysis: A History of the Institute for Water Resources, U.S. Army Corps of Engineers* (Alexandria, VA: Institute for Water Resources, 1996), pp. 296-297, for more details on the National Recreation Study.

[119] "Southwestern Division Command Briefing," December 1993.

[120] *Arkansas Democrat Gazette* (6 July 1993).

[121] Ibid.

[122] Ibid.

Chapter Four:

Diverse Work

During the period 1986-1994, the Southwestern Division undertook a host of activities generic to the Corps of Engineers, and specific to the states of Texas, Oklahoma, New Mexico, and Arkansas. In this time of transition and change for the entire Corps, field operating agencies were challenged with continuing responsibilities and a host of new tasks. The SWD laboratory underwent extensive reorganization and renovation to respond to a diversifying and increasing workload. As recreational use continued to increase in the rapidly growing states of the Southwest, division personnel refined and improved management of the many recreational facilities in the region. SWD also coordinated a variety of projects for other government agencies. Within the division's area of operations, a spate of natural disasters beset the region, testing the capability of the Corps' flood control systems. Meanwhile, the division struggled to maintain traditional services as the Corps streamlined its workforce.

The Southwestern Division Laboratory

The Southwestern Division Laboratory (SWDL) dates back to the late 1930s, when the Corps established a soil testing facility for the Denison Dam site. The Corps built such facilities at dam construction sites where soil plasticity affected



SWD laboratory personnel (above and on following page) test samples for strength and reliability. SWDL supports other Corps field offices and other government agencies.



SWD laboratory personnel testing samples for strength and reliability.

the placement of dam footings. In 1947, the Office of the Chief of Engineers selected the Denison laboratory as one of six to conduct new freeze-thaw tests of concrete aggregates. Two years later, SWD moved the facility to Dallas to perform soil testing throughout its area of operations. During the early years, the laboratory tested mostly soils, concrete, and riprap (the protective rock covering used on earthen dams, levees, and shore protection structures).

In 1951, SWDL became a center for procuring diamonds for drilling tools used by the Corps and other agencies, including the Tennessee Valley Authority and Bureau of Reclamation. The Corps and other water resources development agencies used diamond drill bits to sample foundations at dam and building sites. Together with specialists at the Ohio River and the North Pacific divisions, SWDL personnel determined the Corps-wide specifications for industrial diamonds and developed a process for salvaging diamonds from used drill bits. In 1959, the laboratory became the Corps' central facility for all testing, salvaging, and standardization of industrial diamonds, and shortly thereafter was the sole procurer of diamonds for the entire agency.[1]

During the 1960s, SWDL expanded its operations. In response to a 1961 incident in which Waco Dam slid slightly from its original foundation point, laboratory personnel developed a device for testing soil resistance.[2] The innovation provided an important new tool for improving all Corps dam building projects. In 1962, laboratory personnel developed additional devices for testing soil samples that significantly increased the accuracy of shear-strength soils testing.[3] Four years later, laboratory personnel pioneered the first Corps test for absolute minimum strength of clay shales. They also conducted new tests of riprap materials, further refining testing accuracy for assessing the impact of freezing and thawing.[4]

During the 1970s and 1980s, the laboratory continued to expand its activities. Responding to the growing problem of water and soil pollution, laboratory personnel refined their ability to test for toxins and hazardous materials. To facilitate such tests, the laboratory obtained an atomic absorption spectrophotometer, a gas chromatograph, a total organic carbon analyzer, and a specific ion analyzer. These instruments could detect concentrations of pollutants in parts per billion, meeting EPA standards. Laboratory personnel then developed a computerized database for monitoring, storing, and plotting results. The database was available to district personnel through a new computer network.[5] To enhance quality control and permit the laboratory to be run by fewer people, division personnel increased the automated capabilities at SWDL.[6] Between 1965 and 1994, the laboratory staff declined by 50 percent, from 50 to 25 workers. Beginning in 1986, SWDL acquired the necessary combination of computer hardware and software for automated testing control. For a time, laboratory personnel continued to conduct manual tests in conjunction with computerized testing while they were perfecting the

new system.[7] The introduction of computer-controlled testing equipment enabled SWDL to continue its high-level workload with fewer personnel on-site.[8]

To better serve the changing needs of its customers, the laboratory underwent other transitions during the 1980s. In 1982, the division divided the laboratory into two parts: a Field Services Section and a Physical Testing Section. Field Services handled diamond tool operations, bore hole and television camera field work, and petrography; Physical Testing was responsible for all soil, rock, chemistry, concrete, asphalt, and materials testing. Laboratory personnel conducted many of the physical tests by casting cement test specimens, beams, and cylinders using different combinations of raw materials. The samples were cured in special rooms with controlled temperature and humidity and then removed and broken under controlled levels of pressure to determine their strength. Occasionally, laboratory personnel conducted tests on existing structures. At Fort Bliss, for example, the red brick used to build the Sergeants Major Academy became covered with a white powdery substance. The laboratory tested the material and confirmed that it originated from the bricks and not from another source.[9]

Throughout the 1980s and 1990s, SWDL's work continued to shift toward chemical analysis. Most of the laboratory's tests concerned environmental evaluations, such as analysis of soil and ground-water samples for harmful organic and inorganic compounds. Such evaluations were becoming a vital part of the Corps' increasing role in hazardous waste analysis, monitoring, and clean-up activities at polluted federal sites. In 1987 alone, the Corps budget included $100 million for work in the federal Superfund program, $80 million for the Defense Environmental Restoration Program's (DERP) Formerly Used Defense Sites (FUDS), and another $80 million for DERP's Installation Restoration Program (IRP), which included defense locations still in use.[10] The agency's commitment to environmental restoration created more work for SWDL. By 1994, environmental and chemical testing comprised more than three-fourths of the laboratory's work.[11]

During the 1980s and 1990s, SWDL increased its work for outside agencies. In 1993, for example, the laboratory performed a pilot study for an EPA Superfund project in West Dallas. This project involved testing soil, water, paint chip, and dust filter samples from homes built near an old lead smelter and recycling plant that ceased operations in 1984. The laboratory performed analysis on soil and water samples while contracting out the task of analyzing paint chip and dust samples to other laboratories. Such contracting had become a common practice at the laboratory during the 1990s, since the increasing workload exceeded the in-house capability of personnel and equipment. By 1994, the workload had become so large that the Dallas laboratory performed only 25 percent of the chemical analysis at the Cass Street building.[12]



SWDL, located on Cass Street, in Dallas, Texas.

The expanding work of the laboratory reflected the importance of this Corps facility. Outside agencies found SWDL reliable, convenient, and efficient. According to Robert Griswold, an EPA Superfund remedial project manager, the laboratory and its personnel had unique capability and knowledge that made it an ideal choice for Region 6 EPA work.[13] Griswold recalled that, in 1989, the EPA conducted a nationwide search for a laboratory to handle both environmental and geotechnical testing of samples from the Gurley Oil Pit, a Superfund site near West Memphis, Arkansas. SWDL was the only facility capable of conducting tests of the unique Gurley Pit sludge, an acidic mixture stabilized with cement, lime, and various other materials.[14] From diamond bit technology to sophisticated soil and water contamination analysis, SWDL maintained a high level of expertise and capability, for both the Corps and other customers.

Work for the Department of Energy: Pantex

During World War II, the War Department built many facilities throughout the nation for the production of munitions. Pantex, located near Amarillo, Texas, was one of those plants, built specifically by SWD for the Army Ordnance Corps in 1942. The principal operation at Pantex was loading bombs and artillery shells with the explosive trinitrotoluene (TNT). Beginning in 1950, the Department of Defense converted Pantex into a final assembly plant, shipping nuclear weapons components there for both assembly and testing. Pantex dealt specifically with weapons designed by the Lawrence Livermore Laboratory in Berkeley, California. In 1975, after the nuclear weapons assembly plant in Burlington, Iowa, closed, Pantex became the only such plant remaining in the nation.[15]

During the Cold War years, the United States built approximately 70,000 nuclear weapons. As tensions eased during the late 1980s, the dismantling of many of these weapons became a priority. The Department of Energy (DOE) responded by converting Pantex into a weapons disassembly plant, contracting with SWD to add new facilities under the Corps' Work for Others program. By the 1990s, Pantex included 323 buildings and 1,900,000 square feet of work space valued at over $3 billion. By 1992, following the closure of other DOE facilities, such as the Rocky Flats plant in Colorado, the workforce at Pantex increased to 2,600 employees. New facilities included a $30 million disassembly building, designed with interlocking 4-inch steel doors and 2-foot-thick steel-reinforced concrete walls to dampen any accidental blasts.[16]



The Tulsa District's expansion of Pantex supported the Department of Energy. Activities during the 1980s included asbestos removal from old facilities (above) and new construction (facing page).

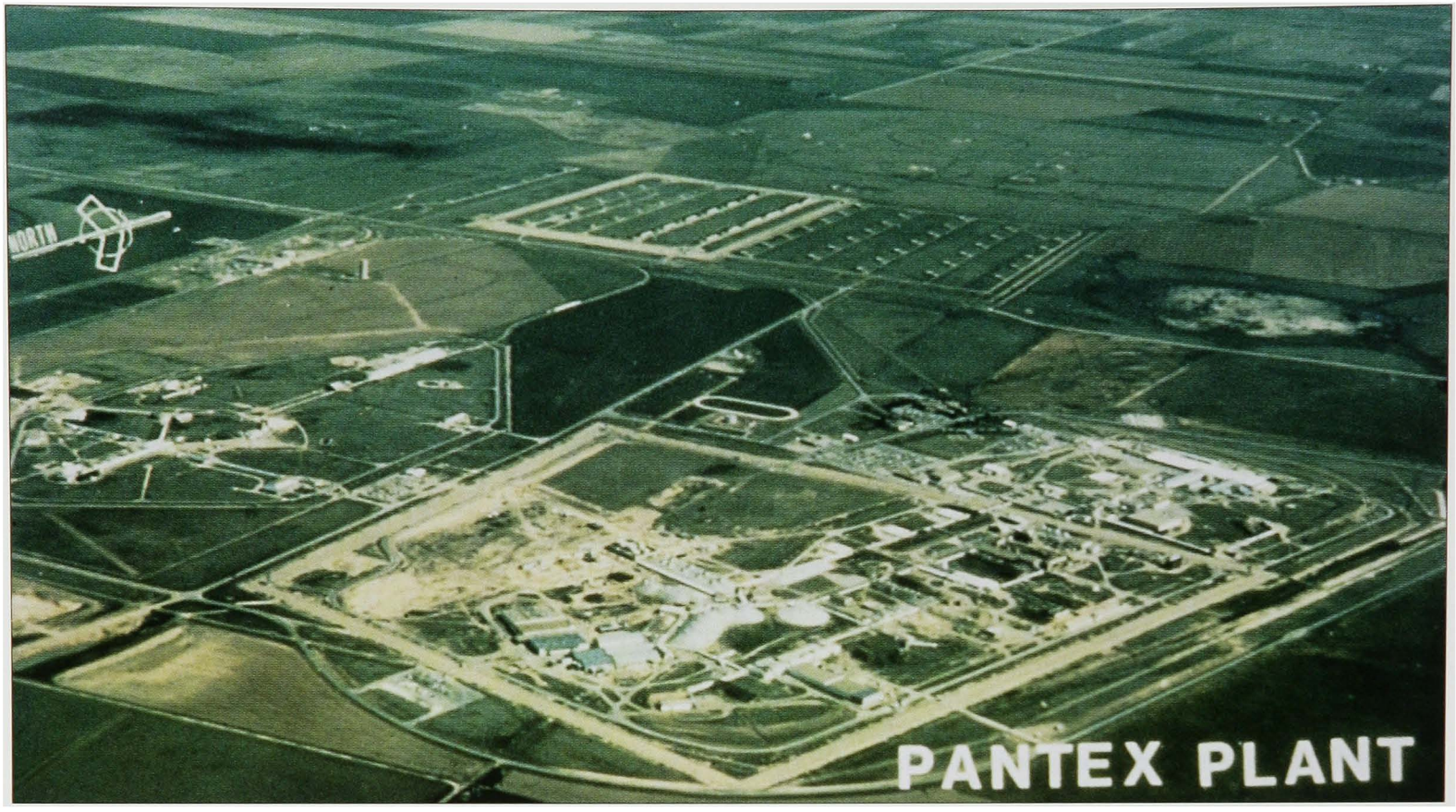
During the 1990s, between 500 and 600 workers disassembled an average of seven warheads each day. Workers began by dismantling older 1960s warheads, such as nuclear artillery shells and Lance missile warheads. Their first task was to remove chemical explosives from the nuclear weapon. This work took place in assembly cells known as "gravel gerties," so called because they had specially designed collapsible gravel ceilings that would contain weapons components in the case of an accidental explosion. Once the conventional explosives were removed from the weapons, they were incinerated at the Pantex Plant. According to unofficial sources, the Pantex facility incinerated an average of 227,000 pounds of explosives annually between 1981 and 1986.[17]

The fissionable material removed from the warheads presented significant storage problems. The nuclear material extracted at Pantex could not be incinerated. Materials such as uranium, lithium-6 deuteride, and tritium were shipped to storage facilities at Oak Ridge, Tennessee, and Savannah River, South Carolina;[18] plutonium cores or "pits" were stored at the Pantex facility in 18 earth-covered bunkers. In compliance with the Strategic Arms Limitation Agreement of 1993, the United States continued to dismantle nuclear weapons at Pantex through the mid-1990s.[19]

SWD's work at Pantex began in 1981, when the Corps developed a Memorandum of Understanding (MOU) for construction with DOE. Since 1981, the division has managed 16 major Pantex construction projects valued at over $165 million.[20] These projects, usually requiring 2.5 years to complete, had an average cost of approximately $10 million. For the first 5 years of the MOU, the division's Fort Worth District directed work at Pantex. In 1986, the division transferred authority to the Tulsa District. Corps contracts included construction of a special-purpose assembly bay for housing high-tech testing devices, high-vacuum chambers, and high-energy x-rays. SWD also built a facility for machining pressed high-explosive components to specific shapes and configurations. Another major project included construction of a $13 million, 40,000-square-foot component staging facility.[21] The division's work at Pantex earned the praise of Corps headquarters. In a Design/Construction Evaluation (DCE) report regarding the work, the Construction Division, Directorate of Military Programs, stated "the quality of construction at Pantex in Amarillo was definitely superior and can be compared favorably with any construction evaluated by the DCE teams."[22]

SWD's work at Pantex also included monitoring and cleanup of potentially dangerous pollutants. In 1989, the Tulsa District became the first Corps office to manage an environmental restoration project (ERP) for DOE. The restoration program addressed pollutants at 143 waste sites. The level of Corps activities in the ERP for Pantex grew from





An aerial view of the Pantex plant in the 1990s.

$30,000 in 1989 to $2.9 million in 1990, $8.1 million in 1991, $16.4 million in 1992, and $27 million in 1993.[23]

Interest in pollution from activities at Pantex reached a peak in May 1994, when the EPA added the facility to its Superfund list. EPA officials believed that toluene, used extensively as a solvent in weapons production, had leached as much as 329 feet below the surface at the site, affecting the area's largest groundwater source – the Ogallala Aquifer – some four miles distant.[24] The EPA and local environmental groups were also concerned about on-site storage of plutonium. At EPA's request, Corps personnel installed monitoring wells to measure contamination of groundwater near the Pantex plant. The monitoring wells revealed concentrations of solvents and gasoline constituents in the perched groundwater aquifer, which ranges 50-150 feet above the Ogallala Aquifer. The Corps continues to monitor contamination levels at this site.[25]

The work at Pantex has presented SWD with myriad challenges, ranging from the construction of facilities for dismantling the world's largest and most sophisticated nuclear arsenal to the cleanup of pollutants threatening an important freshwater aquifer. Both tasks involved work for other agencies, including the DOE and EPA. The division's work on Pantex remains a vital component of international peace.

Flood and Disaster Response

Flooding was a persistent problem in the Arkansas, Red, and White river basins during the late 1980s and early 1990s, plaguing virtually all states in the division and threatening both urban and rural developments. SWD coordinated efforts to respond to major floods in 1986, 1989, 1990, 1992, and 1994. Over the past decades, the Corps had constructed numerous systems for flood control throughout SWD area of operations. Several times during this period, however, record-setting floods exceeded the capacity of flood control structures. As a result, the Corps' emergency response infrastructure played a critical role in directing flood relief efforts.

Flood of 1986

During the early autumn of 1986, heavy rains began falling over north central Oklahoma and south central Kansas. During one week of steady deluge in late September and early October, the area received almost one-half its normal annu-

al rainfall.[26] This was only the beginning, however. Continual rains made this a flood of record along many tributaries of the Arkansas River.

Prior to the flood, SWD, working with the Tulsa and Little Rock districts, developed a comprehensive flood release plan for the Arkansas River and its tributaries. The Corps developed the plan at the request of Congressman Wes Watkins of Oklahoma and Senator David Pryor of Arkansas, both of whom wanted to minimize flood damages and navigation "downtime" in their states. Completed in June 1986, the plan initiated controlled releases from 11 Oklahoma reservoirs during heavy rains that would prevent flooding in both upstream and downstream reaches.[27] It also called for the reduction of flood storage levels in the reservoirs so that, during heavy rains, releases would not be large or concurrent with the storms.[28]

During the summer of 1986, the Corps reduced the flood storage levels of reservoirs in the Arkansas River system. Even at these reduced levels, however, the flood control system in place was not sufficient for the storms that struck the Arkansas River basin in September and October. On September 26, each of the Corps reservoirs in eastern Oklahoma, including Keystone Lake, had empty flood control pools. The dry summer had resulted in three percent additional flood control capacity. Some reservoirs had even dropped below the tops of the conservation pools. During the next few days, unusual weather patterns developed that produced flooding in several uncontrolled areas of the basin. In response, the Corps released no water from its upstream reservoirs. The rains continued until the end of September. Keystone Lake rose steadily to the top of its flood control pool, while flooding in uncontrolled drainage caused damage in Bixby, Oklahoma, where levees broke, and at Van Buren, Arkansas, just east of the Oklahoma border. Uncontrolled runoff also resulted in flooding on the Caney River near Bartlesville, and along the Grand and Illinois rivers.[29]

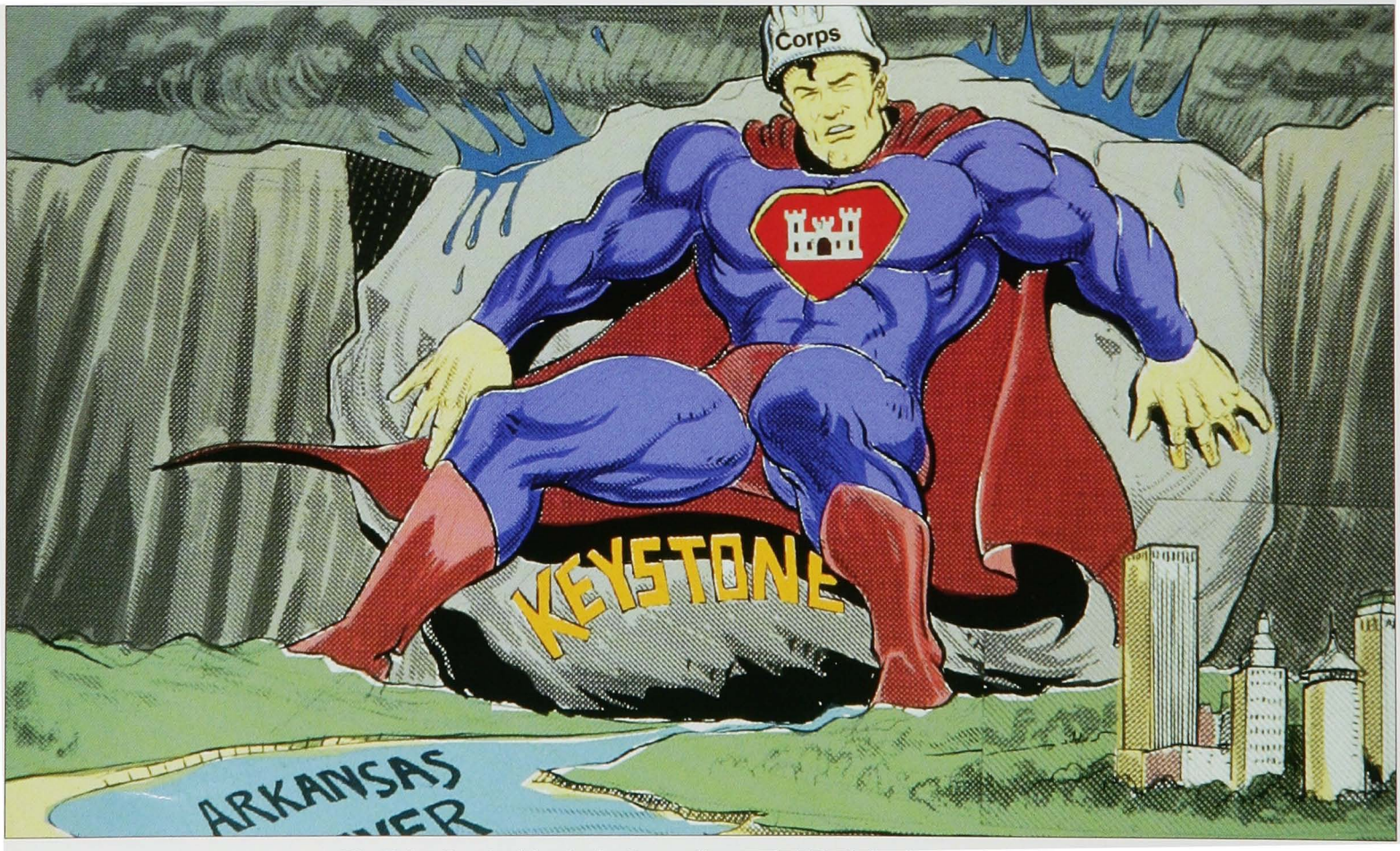
Heavy rains continued into early October. Forecasts suggested that Tenkiller Lake in eastern Oklahoma would soon reach storage capacity if there were no releases. Rain continued, and the remnants of Hurricane Paine threatened to bring heavy thunderstorms to Oklahoma. On 2 October, Keystone Lake was at risk of overtopping following a seven-inch deluge near Bartlesville. With several dams above Keystone already at capacity, the Corps began releasing water from the huge dam above Tulsa. By 4 October, the Arkansas River had reached flood stage near Muskogee. Two days later, flooding was widespread throughout the Oklahoma drainage of the Arkansas. As the rains began to subside, the Corps deviated from its normal policy of waiting until downstream flooding was over. Because of the widespread flooding upstream, the agency continued releases from Keystone and the Robert S. Kerr Lock and Dam. By 13 October, the Corps restored area lakes to levels that could handle moderate rain without additional flood damages.[30]



Flooding was widespread in Oklahoma. Above, the Caney River near Bartlesville.



Keystone Lake (Oklahoma, 1986) at capacity.



The Tulsa Sentinel *lauds the Corps efforts to hold back floodwaters in 1986.*



Major General Jerome B. Hilmes, SWD Commander, at a press conference along the Arkansas River near Tulsa, during the 1986 flood.

Flooding throughout the area was extensive, causing significant damage in Sand Springs (below Keystone) and other cities along the Arkansas River. The Corps encountered intense criticism from flood victims for its decisions regarding the releases. The Corps, however, defended its actions with statistics. Using information provided by SWD, Tulsa District Engineer Col. Frank M. Patete issued a detailed account of the agency's decisions during the storm.[31] Patete maintained that almost one-half of the area's annual normal precipitation had fallen in just a few days, calling the storm a 100-year event. Hurricane-induced rains had caused an eight-inch deluge in a matter of hours. In Patete's estimation, the Corps' releases reduced flooding levels by more than 5 feet at Bartlesville and Tulsa, and more than 14 feet at Muskogee. In several instances, the Tulsa District had obtained approval from SWD to let reservoir levels rise higher than the safety zones to reduce sudden releases. Patete credited the coordinated efforts of the Corps and its flood control works for saving many lives and millions of dollars in property damage.[32]

The Corps' emergency response also lessened the human costs of the flood. Three days before the official emergency began on 1 October, the Corps had received Public Law 84-99 authority to begin around-the-clock emergency operations in eastern Oklahoma. PL 84-99 allowed the Corps to mobilize through the Federal Emergency Management Agency in advance of actual disaster relief funding. The warnings and relief efforts aided flood victims while extensive sandbagging operations reduced property and human losses.[33]

The Oklahoma flood of 1986 revealed the complexity of the Corps' tasks in flood prevention, and demonstrated that flooding in areas without flood protection is inevitably tied to the entire flood control system. The 1986 flood also showed that enough precipitation in a short duration could cause flooding, regardless of the system in place.

Flood of 1989

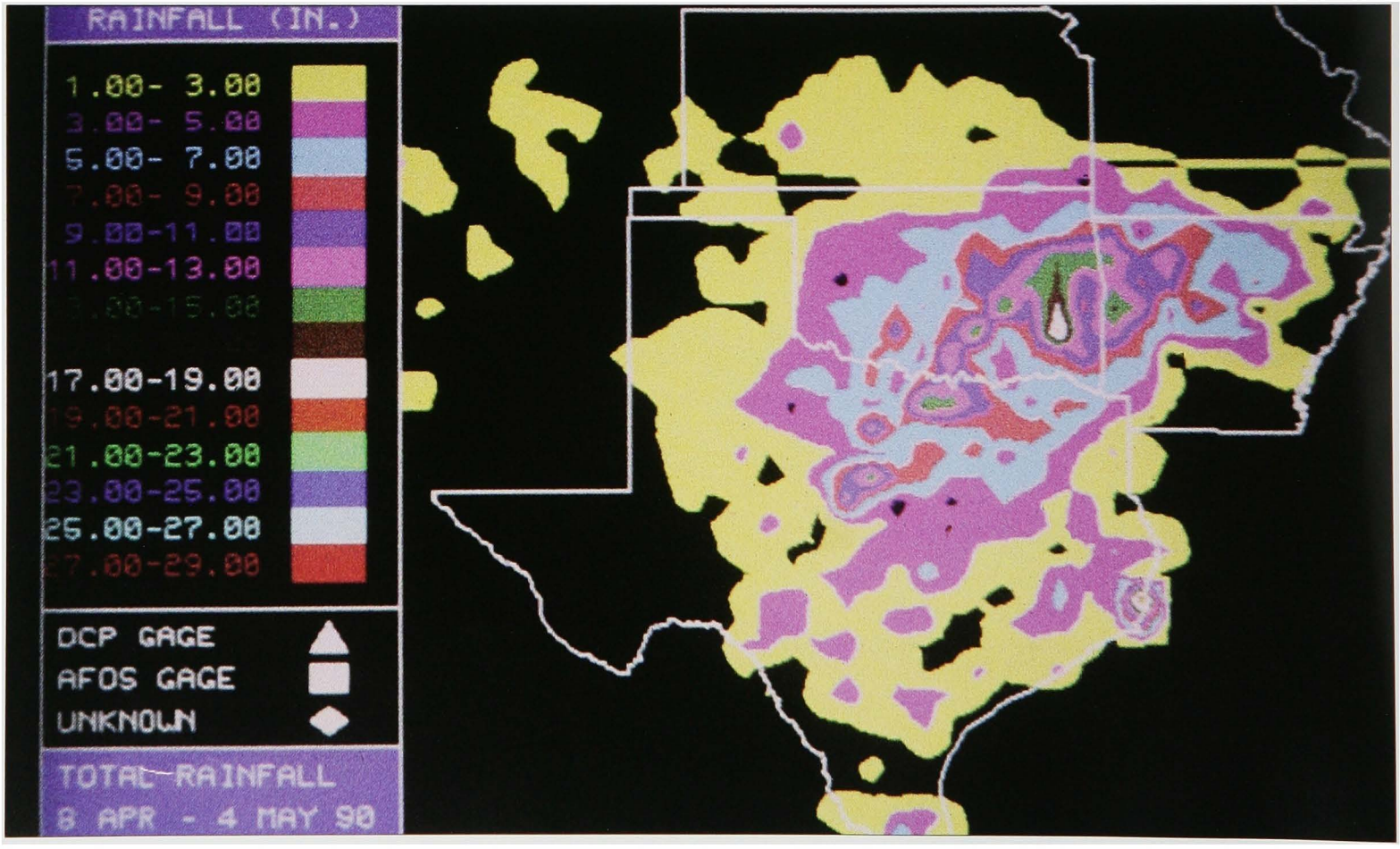
Three years after the Arkansas River flood, severe weather took its toll on parts of Texas. In May 1989, flash flooding occurred in north central Texas for several weeks. Three major storms sent streams and rivers to crest, as the region received the second highest amount of rainfall ever recorded for May. The second storm, occurring 16-18 May, had a severe impact on residents living in the floodplains of the Dallas metropolitan area. The city's Five Mile Creek flooded, "destroying homes and everything else along its banks, including 150 brand-new police cars parked along the creek."[34] During the second storm, 90 percent of the water falling over the metroplex emptied into the Corps-built Dallas Floodway, preventing millions in damages to the city. One week later a third storm hit, dropping as much as 12 additional inches of rain on the area.

Throughout this disaster, Corps flood control facilities performed as designed. Corps lakes stored billions of gallons of storm water. Benbrook Lake, for example, stored 117,500 acre-feet of water; Lewisville, 352,600; Grapevine, 274,700; and Lavon, 294,900.[35] Overall, Corps flood control projects in the Trinity River basin of north Texas prevented a great amount of flood damage in the Dallas/Fort Worth metroplex. According to Doug Perrin of the Fort Worth District Reservoir Control Section: "[W]e hold the floodwaters in our lakes until downstream conditions improve to such a degree that we can slowly release some of those waters without making the flooding any worse. By doing that, we gain back that flood storage space in the lake for the next rains."[36] At the conclusion of the 1989 flood, Corps flood control works had handled over 20 inches of rain in 2 months. Average annual rainfall for an entire year in this area was only 29 inches.[37]

During June, flooding became even more widespread, extending southeastward toward the Gulf of Mexico. SWD worked closely with the Fort Worth District to handle the emergency. District personnel monitored cubic-feet-per-second flows and other data, sending the information to the division every four hours. Using this information, the division's



The Dallas Floodway reaches capacity during the spring 1989 flooding in Texas.



Rainfall totals in the SWD area of operations between 8 April and 4 May 1990.



Unprecedented river flows mandated massive releases of water from Corps dams in Oklahoma, Arkansas, and Texas. Dardanelle Lock and Dam in Arkansas (above) and Tenkiller Dam in Oklahoma (following page).

Emergency Management Directorate formulated responses for areas experiencing acute flooding problems. At B.A. Steinhagen Lake in southeastern Texas, the Corps released an amazing 45,000 cubic feet of water per second during late June. The combined flows out of Steinhagen and its sources near Beaumont reached nearly 80,000 cubic feet per second, or 600,000 gallons per second.[38]

Although the rains abated in July, residual problems persisted. Roads remained under water, and downstream flooding prevented greater releases from Corps reservoirs. Many Corps parks and recreation areas remained closed through July, normally the peak of the recreational use season. As a result, Corps reservoirs lost as much as 75 percent of their normal recreational use fees.[39] Some lakes did not reopen for recreational use until shortly before Labor Day. The impact was greatest on the Corps' special fund for park maintenance and repairs, and on vendors and businesses that depended on recreational use.[40] After the floodwaters receded, the Corps estimated that its flood control works in the Trinity River basin had prevented more than $184 million in damages in north central Texas.[41]

Flood of 1990

Heavy spring rains in 1990 caused flooding in three of the five districts in SWD. Beginning in April, a series of thunderstorms dropped tremendous rainfall over southeastern Oklahoma, western Arkansas, and northeastern Texas. Few believed that a record flood in the Arkansas River basin would occur so soon after the 1986 emergency. Few also thought that northern Texas would receive widespread flooding reminiscent of the summer of 1989. However, three weeks of frequent storms again caused flooding in uncontrolled areas of Texas, Oklahoma, and Arkansas, filling reservoirs throughout the region to capacity.

On Friday, 27 April, the Corps Public Affairs Office in Tulsa began distributing information on the high lake levels in much of the district. In coordination with SWD, project offices at Lake Texoma and Lake Eufaula announced the closings of most of the recreation areas at both facilities.[42] Meanwhile, weather forecasters in north Texas correctly warned that more heavy rains would be falling in the Red River basin on 26-27 April. Even before this round of storms, north Texas had received more than 19 inches of precipitation for 1990, almost 10 inches more than normal.[43] By 3 May, Lake Texoma had



Unprecedented river flows mandated massive releases of water from Corps Tenkiller Dam in Oklahoma.

exceeded its flood control capacity, and releases began despite downstream flooding. In Oklahoma, Sardis, Wister, and McGee Creek lakes were filled to flood control capacity.[44]

Following a brief respite, severe storms with heavy rainfall resumed in eastern Oklahoma and north central Texas. Despite significant releases, Lake Texoma flood waters overtopped a reserve spillway at Denison Dam. This was the first time water had gone over the spillway since 1957. The National Weather Service issued flood warnings for 50 counties in Texas and Oklahoma.[45] Flooding in Texas extended from Cook County, on the Oklahoma border, south to Travis County, north of Austin. Lake Eufaula in southeastern Oklahoma, which had reached its highest elevation ever on April 28, continued to rise in May. On 3 May, the lake reached still another record of 599.41 feet above sea level. The dangerously high level forced the Corps to begin releases into the lower South Canadian River, which emptied into the already flooded Arkansas River basin.[46]

The releases into the Arkansas River meant that additional flooding would occur downstream. On 3 May, the Little Rock District Public Affairs Office announced a major flood on the Arkansas River, with flows exceeding 400,000 cubic feet per second. Such flows forced the Corps to close two locks and dams on the McClellan-Kerr Waterway.[47] The following day, the Arkansas River crested 13 feet above flood stage at Van Buren, 15 feet above at Ozark, and 4.5 feet above at Little Rock.[48]

As the flooding worsened, SWD responded. Using PL 84-99 funds, division personnel oversaw the opening of emergency operations centers (EOCs) in Texas, Oklahoma, and Arkansas. The EOCs responded to thousands of concerned callers, and also distributed information on evacuations, sandbagging operations, and weather forecasts.[49] Rains continued in early May, forcing evacuations in north Texas and central Arkansas. For north Texas, the 1990 flood exceeded the 1989 event, with people calling it "the worst in 80 years." The Dallas-Fort Worth Airport canceled hundreds of flights as floodwaters inundated the runways.[50]

By mid-May the rains subsided, allowing officials to assess the extensive damage in the three states. General Accounting Office investigators found that the Corps flood control works had functioned as designed, and prevented $126 million in damages in the Red and Arkansas River basins.[51] In the wake of the floods, Senator David Pryor of Arkansas called for an investigation of the Corps' management of its reservoirs. The GAO report concluded that the "Corps generally operated the nine reservoirs in accordance with its operating procedures before, during, and after the May 1990 flooding." The study also found, however, that three releases–one at Tenkiller, one at Texoma, and one at Hugo–did not comply

with standard Corps procedures, and may have prolonged flooding of "rural lands predominantly in Texas and Oklahoma." Yet the report pointed out that the releases were necessary to maintain the safe operation of the reservoirs.[52]

Flood of 1991-1992

The next round of severe flooding in SWD occurred 18 months after the 1990 storms. Unusual weather conditions in Texas resulted in long periods of rain throughout December 1991. By Christmas Day, flooding was widespread in northern, central, and southeastern Texas, and had caused 17 deaths. The Colorado River, which flows through central Texas, extensively damaged Austin, while rivers throughout southeastern Texas overtopped their banks and flooded hundreds of homes and businesses.[53] The flooding became so severe that President George Bush traveled to Texas to tour flooded areas. After declaring five counties in Texas disaster areas, Bush called what he had seen "a particularly bitter calamity during this holiday season."[54]

By early 1992, the Texas floods involved five major rivers: Trinity, Brazos, Colorado, Guadalupe, and San Antonio. Austin set an all-time record for rainfall in December of 14.16 inches, and the Dallas-Fort Worth yearly total reached 53.54 inches. By 17 January, President Bush had declared 42 counties in Texas disaster areas. Again, Corps flood control works functioned as designed in the Trinity River basin and other controlled areas. Corps reservoirs in the flood areas held back water while downstream reaches dried out. In all, Corps flood control lakes prevented an estimated $3 billion in damages to industries and residences.[55]

As the rains subsided in late January, the Galveston and Fort Worth districts, in coordination with the division, released water from the reservoirs to allow for the coming spring rains. Emergency management work, coordinated by SWD, began in December and extended into January.[56] This work included emergency spillway modifications to five reservoirs on the Brazos River, and emergency construction of a spillway at Sam Rayburn Reservoir.[57] Meanwhile, the Galveston District set up an EOC and began constant tracking of rainfall and water levels in creeks and rivers. The district released information to the public as well as passing it along to the division and FEMA.[58]



Flooding during 1990 in Fort Smith, Arkansas. The region was beset with more major floods in each year of the early 1990s.



Flooding during 1990 at Lake Texoma (Oklahoma-Texas border).

Flood of 1993

Based on the experiences of the floods of 1986-1991, SWD stepped up efforts to coordinate flood control responses at the district level. When slow-moving storms sent reservoirs to their flood control capacities in eastern Oklahoma in May 1993, the Corps anticipated flooding in the Arkansas River basin. By staggering releases from Keystone, Eufaula, and other reservoirs, and correctly predicted rainfall, the Corps was able to minimize damage.[59] Estimates from this short, but intense series of storms, were that Corps management of its flood control works prevented almost $2 billion in damages.[60]

With its large system of flood control structures, SWD plays a crucial role in the economic and social well-being of Texans, Oklahomans, Arkansans, Kansans, and New Mexicans. Flood damages prevented by the division's facilities during the 1986-1994 period ranged from a low of $189.5 million in fiscal year 1988 to more than $6 billion in fiscal year 1994. On average, Corps facilities prevented more than $2.5 billion in flood damages annually during those years.[61]

The volatile weather of the Southwestern plains has from time to time played havoc with residents of the area. Minimizing damage and initiating proper disaster response is an immense challenge to SWD. With increasing information regarding weather patterns, Corps officials are better coordinating water releases in the various river systems to minimize the impact of flooding. The challenge is great, as the years 1986 - 1994 proved.

Other Activities

Between 1986 and 1994, SWD was involved in a variety of other activities, some of which were traditional and some of which involved new directions for the division. In real estate, for example, SWD played an integral part in both military and civilian programs. The Real Estate Division handled several projects for the military services, including leasing property for the Armed Forces Recruiting Facilities program, and acquiring property for the Homeowners Assistance Program in the Fort Worth District. The Real Estate Division also represented outside agencies such as the DOE and EPA. When Carver Terrace, a subdivision near downtown Texarkana, Texas, became an EPA Superfund site in 1984 because of high concentrations of creosote in the soil and groundwater, the Real Estate Division arranged the pur-



The Fort Worth District supported the Drug Enforcement Agency with construction of this hangar at Alliance Airport in Fort Worth, Texas.

chase of the homes in preparation for remediation of the site.[62]

Other unusual projects for SWD included support for Joint Task Force Six (JTF-6) operations along the United States border with Mexico. JTF-6 trained active and reserve military personnel in support of federal, state, and local illegal drug interdiction programs. The Corps' role was to assist JTF-6 and the Immigration and Naturalization Service in complying with NEPA. The Corps prepared a programmatic environmental impact statement that entailed one of the most comprehensive surveys ever conducted in the border region. The Fort Worth District produced a five-volume description of existing conditions that covered "economics, threatened and endangered species, water and air quality, and cultural resources along the United States-Mexico border to 50 miles north, as well as the Texas Gulf Coast."[63] As a result of JTF-6, the Corps supported improvement of 600 miles of road along the border, helping the border patrol increase drug arrests.

In addition to its traditional military construction and civil works responsibilities, the Southwestern Division performed myriad other services for both the Southwest region and the nation in the late 1980s and 1990s. The division laboratory developed automation techniques that improved physical and environmental testing. In work for DOE at Pantex, the division oversaw the construction of facilities aimed at the first major reduction of the U.S. nuclear arsenal since World War II. As a principal recreation provider, SWD maintained dozens of sites while also experimenting with new management approaches. Meanwhile, the division responded to floods and disasters, and provided other services to the region. As the 1990s progressed, the division's work became even more diverse.

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Chapter Five:

Serving the Southwest in an Era of Change

In the period 1986-1994, SWD underwent significant transitions. Much of this change took place within the context of an overall transformation of the U.S. Army Corps of Engineers. The Corps' military construction activities experienced sweeping changes with the end of the Cold War and the eventual demise of the USSR in 1992. Military construction, which had peaked during the Reagan years, began a steady decline, including not only reductions in defense-related activities, but also realignment and closure plans for many military installations. With its large military construction budget, SWD experienced these transformations in U.S. defense policies firsthand. The division played an important role in implementing new directions and policies at the many military installations in its area of operations.

Transitions within SWD civil works were also significant. The continuing shift away from large water resources projects reshaped the Corps' entire civil works program, as divisions assisted districts in implementing the provisions of the sweeping Water Resources Development Act of 1986.

Cost-sharing requirements in civil projects and changing military construction needs prompted the Corps to adopt the new approach of program and project management. At the divisional level, program management required personnel to be ever more innovative and flexible in handling both of the agency's major missions. This task was all the more challenging as the Corps underwent a prolonged reorganization of its field operating agencies.

Reorganization

The early 1990s were a turbulent time for Corps field offices during which a complete reorganization of the Corps was planned. At both division and district levels, Corps personnel faced the possibility of layoff or transfer. No district or division



The Sante Fe Building, downtown Dallas, remains the headquarters of the Southwestern Division.

was immune to complete closure. Reorganization, first mentioned in the 1990 Energy and Water Appropriations Act, would be the first major restructuring of the Corps since 1942, when the agency had expanded to meet the requirements of World War II.

Corps efforts for restructuring began in June 1990 with the assembly of a task force headed by Fred Bayley of the Lower Mississippi Valley Division. In a January 1991 report, Bayley and 10 other members presented these criteria for consideration in the general reorganization: "cost, flexibility, competence, and six organizational alternatives, including realignment, regionalization, decentralization, elimination of divisions, and combinations of each." After reviewing the report, Assistant Secretary of the Army for Civil Works Nancy Dorn added management efficiency to the list of criteria.

While the Bayley team continued its deliberations, the Corps also established a Reorganization Study Team headed by then Director of Civil Works Major General Arthur E. Williams. The Reorganization Team developed a report that became a part of the Base Realignment and Closure (BRAC) process. In April 1991, however, members of Congress who were concerned about the local impact of reorganizing Corps offices (and who did not believe the Corps' civil works program should be included in the BRAC process) persuaded Secretary of Defense Dick Cheney to remove the Corps from the BRAC process. In June, the BRAC commission restored the Corps to the process, but in November 1991 Congress removed Corps field operating agencies conducting civil works activities from BRAC considerations. Congress also prohibited funds from the fiscal year 1992 Energy and Water Appropriations Act from being used to close Corps districts or divisions. In the Defense Authorizing Act for 1992, Congress, by statute, removed all Corps civil works facilities from BRAC consideration.

In response to congressional action, the Corps in July 1992 organized a second task force headed by Ohio River Division Commander Brigadier General Al Genetti. Working with headquarters staff, the Genetti task force discussed and refined the findings of the Bayley group's 1991 report, and recommended an approach to reorganization based on cost-effectiveness, flexibility, competency enhancement, and managerial efficiency.

Following the Genetti report, a field advisory committee with representatives from each division and district began reviewing potential field office closures. The committee attempted to evaluate which division headquarters should be closed, based on factors such as cost of living, workloads, and proximity to transportation hubs. A special committee composed of Corps and Army leaders completed the reorganization plan and presented it to the BRAC planners in November 1992. The committee projected that the cutbacks would eliminate 2,600 employees in headquarters and field offices. The reorganization would cost $215 million to implement, and result in an annual savings of $115 million by 1995.

The Corps reorganization plan called for a nearly 50 percent reduction in the number of civil works divisions, from 11 to 6. Remaining divisions would no longer act as technical and policy review agents. All districts would remain open and be realigned into the remaining divisions: New England in Boston, Pacific Ocean in Honolulu, North Central (formerly Ohio River) in Cincinnati, Southeastern (formerly South Atlantic) in Atlanta, South Central (formerly Lower Mississippi Valley) in Vicksburg, and Western (formerly North Pacific) in Portland. SWD offices in Dallas were among those to be closed. The South Central and Western divisions would assume responsibilities for the former SWD districts.

Reaction to the Genetti plan at SWD was strong. Employees had been preparing for the worst since reorganization was first discussed in the late 1980s. Nonetheless, disbelief and resentment over the entire process were widespread throughout the Dallas office. For some, however, the news at least had the comfort of ending the uncertainty that had shrouded the division for so long. Uncertainty, according to at least one employee, had long hurt morale. Art Lewis of the SWD Planning Division noted in 1991 a "dramatic fall off in productivity" since the discussions about reorganization began. Such sentiments were common at a July 1991 workshop held at the division. Dr. Barry Rought, director of the SWD Construction/Operations Division and member of the Corps' Leadership Enhancement and Development team, organized the workshop to hear employee attitudes toward reorganization. Corps personnel from the division office and each of its five districts attended. Many attendees spoke openly about the difficulty of "maintaining productivity and positive morale during the uncertainty brought about by the reorganization"; meanwhile, representatives from headquarters assured them that Corps employees were "all in this together."

Budget cuts for the division for 1989-1992 had helped to fuel rumors that the Dallas office would soon close. Division Commander Brigadier General Robert C. Lee recalled that when he first arrived in 1988 he learned that "everything was fine–except we couldn't meet our payroll!" During 1992, Brigadier General Stanley G. Genega, who became SWD commander in 1990, faced a $617,000 budget cut. "We're pulling the belt in everywhere," Genega then observed, "but trying not to cut anyone off at the knees." The division achieved some savings by reducing office space, but the drastic budget cuts also forced personnel reductions. The budget cuts and impending reorganization greatly concerned division personnel, but uncertainty turned to despair when they learned in 1992 that the SWD office would close by 1993.

The difficult task of informing SWD members of the closure fell to Brigadier General Robert L. Herndon, who assumed command in January 1992. Shortly after taking command, Herndon assumed temporary duty in the Reorganization Project Office. When news of the reorganization came, some employees doubted Herndon's earlier assertion he had not been sent to close down the Dallas office. Herndon, however, reasserted that he had had no prior knowledge that SWD would close. On 19 November, Herndon announced the closure in a SWD staff meeting and informed members that some of them could relocate to the new South Central Division in Vicksburg, Mississippi. Next, Herndon listed the reasons the committee chose Vicksburg over Dallas as division headquarters: Vicksburg offered a $715,000 annual rental savings over Dallas; the



The missions of the Southwestern Division remain diverse: Hazardous, Toxic Waste removal at Pine Bluff Arsenal, Arkansas (above); boating and water safety on SWD lakes and waterways (below); shore protection on the Texas Gulf Coast; and military support facilities throughout the area of operations (following pages).





Southwestern Division shore protection on the Texas Gulf Coast.

Mississippi River Commission had to remain in Vicksburg by law; and, finally, the economic impact to Vicksburg of closing that office would be much greater than the impact of closing SWD to the Dallas metropolitan area.

Members of SWD were not mollified by the justifications. They believed the criteria that kept other offices open, such as proximity to transportation hubs and communications, applied everywhere but Vicksburg. With its international airport, passenger rail service, and superior highways, the Dallas-Fort Worth area was a more logical division headquarters locale than Vicksburg. General Herndon, however, reemphasized that the decision was a fair one. Vicksburg District would lose 477 spaces in the reorganization, and the enlargement of the division would only partly restore those reductions. Placing the reorganization in broader terms, he wrote to SWD employees in December 1992:"The reorganization plan will save the Corps – and us as taxpayers – over $115 million per year. . . . The goal is to create a modern organizational structure that will maintain the professional expertise that is the hallmark of the U.S. Army Corps of Engineers. This plan will do that!"

Under the new plan, the Fort Worth, Galveston, Little Rock, and Tulsa districts would report to the South Central Division in Vicksburg, and the Albuquerque District would report to the Western Division in Portland. Although the plan did not actually close any districts, personnel changes were significant. In the existing SWD, the Fort Worth District would gain jobs, with a total of 168 positions to be added to the current 1,175. The Tulsa District would also benefit from becoming one of the Corps' new "technical centers," which meant the addition of 119 jobs. However, the Galveston District was designated to lose 158 of 412 jobs; the Little Rock District, 28 percent of its positions; and the Albuquerque District, 54 percent of its positions.

The Corps reorganization plan drew quick national attention. Elected officials from across the country reacted swiftly and negatively. Galveston Mayor Barbara Crews, for example, estimated that the reductions would drain as much as $8 million a year out of the local economy. In a letter to Deputy Defense Secretary Donald Atwood, Senator Dale Bumpers of Arkansas stated: "I support the goal of streamlining the Corps, but it must be done in a way that all states share the hardship." Bumpers was adamantly opposed to the projected job losses at the Little Rock office, concluding: "As far as I'm concerned, this plan is a nonstarter." Bumpers and West Virginia Representative Nick Rahall went so far as to suggest that the reorganization plan benefited those Corps personnel who were involved in making the cuts. They noted that, of the 12 people on General Genetti's reorganization task force, 8 members, including Genetti, "[would] either have more employees or territory to oversee in the reorganization or else [would] not suffer any losses."

As the Corps reorganization plan became more publicized late in 1992, opposition grew. The Bush administration, which had begun overseeing the reorganization, had not coordinated its progress with the incoming Clinton administration. Les Aspin, Clinton's designated Secretary of Defense, announced his concern about the Corps' reorganization plan, especially in light of allegations that "political considerations may have played a role in determining which offices and units to close and which to keep open." Senator Robert Byrd of West Virginia joined Aspin in criticizing the plan, decry-

ing the decision to cut 365 jobs from West Virginia's Huntington District. Byrd called the plan "a cheap shot at loyal employees by an administration [the Bush administration] with nothing on its mind but leaving." "As far as I'm concerned," Byrd commented, "that plan is DOA, that means dead on arrival."

Opposition to reorganization crossed party lines. Republican Senators John. C. Danforth and Christopher S. Bond, both of Missouri, issued a formal request that Aspin shelve the entire plan. Democratic Senator David Pryor of Arkansas also urged that the plan be withdrawn. "Reorganization," he announced, "seriously affects the private citizens of my state who use the electric energy, the navigation systems, the recreational and the flood control benefits provided through their tax dollars for these civil works projects." In late January, Aspin, responding to congressional pressure, informed the Corps that no plans could go forward without his approval.

While congressional opposition increased, federal employee organizations launched their own campaigns against the reorganization. Organizations such as the National Federation of Federal Employees (NFFE), the International Federation of Professional and Technical Engineers, and the American Federation of Federal Employees lobbied Congress against the reorganization plan. The employee groups warned that the plan "could cost up to four times as much as officials have estimated, and drain the workforce of experience." "Reorganization," they predicted, "would leave the Corps with about 64,000 fewer years of experience, and increase the ratio of managers to employees," according to a NFFE report." Meanwhile, leading Corps officials stated that the uncertainty surrounding reorganization threatened to undermine the agency's future. One high-ranking official warned that "some of the organization's best engineers and scientists are leaving for jobs in the private sector."

Although criticism increased, phase one of the reorganization was still scheduled to begin on 1 February 1993. Corps headquarters had planned a ceremony to both activate the new divisions and close five divisions, including SWD. However, Les Aspin's decision in January to study the plan further prompted Chief of Engineers Lieutenant General Arthur E. Williams to postpone the ceremony. In March 1993, Williams visited the Dallas office for a town hall meeting intended to boost morale. Williams acknowledged the pain that SWD members were experiencing, but emphasized the Corps' need to restructure. With the recent criticism of the plan, Williams also noted, the agency was again in a state of uncertainty, and he stressed the need to "get on with it."

Convinced that SWD's closing was imminent, many employees looked for other options. Over 100 division employees registered for outplacement programs, while others considered retiring or resigning from their positions. By February 1993, 13 SWD office employees had relocated in anticipation of the Corps reorganization. Of these, seven moved to positions in the Department of Defense, three found positions with other federal agencies, and three retired.

Following intense debate in Congress, President Bill Clinton decided to withdraw the reorganization plan from consideration in 1993. Clinton called for another reorganization plan in a budget-cutting bill he subsequently sent to Congress. Congress approved the legislation. The legislators, however, amended the President's request for another Corps reorganization plan, and required that any future studies gain prior congressional approval. Congress was in part reacting to Vice President Al Gore's National Performance Review, which recommended that the Department of Defense implement phase one of the 1992 reorganization plan (the closing of division offices). In the wake of Clinton's decision, General Williams



Southwestern Division provides military support facilities throughout its area of operations.

concurred with Congress, stating that "a new study would be a waste of taxpayer money and hardship for Corps employees." "I think it is totally unfair," Williams added, "to [leave] 40,000 civilians dangling for another year."

On 18 May 1994, Dr. John H. Zirschky, Acting Assistant Secretary of the Army for Civil Works, informed SWD Commander Col. James Paul King that "all division headquarters, including the SWD office in Dallas, will remain open." Zirschky announced a new "restructuring" approach(instead of reorganization(designed to "change how we do business and not where we do business." Restructuring did not preclude the personnel and budgetary goals that called for a reduction of "a total of 3,400 spaces on the civil works side and estimated 1,000 spaces in military programs" over the following 5 years. In June 1994, Zirschky met with representatives of Corps headquarters, divisions, districts, and laboratories to develop and discuss new strategies for restructuring the Corps. Colonel King, the five district commanders, and Paul Robinson, SWD chief of program management, represented the division.

By the end of 1994, reorganization of the Corps had proven to be something more easily planned than enacted. Elaborate designs to streamline and consolidate field offices came face to face with the political realities of the importance of Corps offices to local economies. Ultimately, any reorganization of the Corps will need to address the issues of politics, economics, and local interests in addition to the needs of the agency.

Part of the Corps' 1992 reorganization plan included a management strategy for both civil works and military construction projects, with the objective of reducing Corps management costs. Another part of the plan called for a centralization of financial and accounting data processing through the implementation of a Corps-wide data network, the Corps of Engineers Automation Program and a new Corps of Engineers financial management system (CEFMS). CEFMS was originally part of the Corps' Information Systems Modernization Program (ISMP) that began in 1988, but was particularly hard to implement because of the difficulty of designing an accounting system that conformed with both military and civil procedures. Itemizing each expenditure required a more detailed system than the lumping of expenditures under overhead costs. CEFMS overcame this hurdle by using state-of-the-art computer technology and a screen-oriented, menu-driven database designed to replace the existing Corps Management Information System.



The years 1986-1994 were eventful ones for SWD and the Corps. The civilian employees of SWD faced increasing responsibilities simultaneously with significant reductions in the workforce. Military construction activities were diverse and complex, with projects spanning the division's entire area of operations. Civil works responsibilities intensified as well, as implementation of cost-sharing affected most projects. In military construction and later in civil works, the division's role changed as technical review of district planning reports shifted to the district level, and policy review shifted to headquarters. Division planning thereafter consisted of quality assurance of district-level planning, planning study management coordination, and regional and interagency coordination. SWD personnel also adapted to sweeping changes in resource management, information management, and real estate activities. Periodically, the division responded to major floods that ravaged parts of the region.

Five commanders served SWD between 1986 and 1994, and each had a unique contribution to helping the division meet its new responsibilities. Major General Jerome B. Hilmes (1985-1988), Brigadier General Robert C. Lee (1988-1990), Brigadier General Stanley G. Genega (1990-1992), Brigadier General Robert L. Herndon (1992-1993), and Colonel James Paul King (1993-1995) directed SWD through these eventful years. Perhaps the most significant accomplishment of the agency in these years was a general redefinition of the division's role in Corps activities, which provided each SWD commander with challenges ranging from personnel reductions to agencywide reorganization. Civilian personnel labored to adapt to these changes while Congress and the public demanded that the Corps' traditional missions be maintained.

As a decentralized organization, the Corps experienced unprecedented tension between headquarters and the field offices during the late 1980s and early 1990s. Unprecedented changes emanating from Washington, DC, including declining budgets for military construction and civil works, the increasing influence of the Assistant Secretary of the Army for Civil Works, and passage of the Water Resources Development Act of 1986, tested policy makers and planners in Corps headquarters. Implementing responses challenged field operating agencies, especially district offices. Along with other Corps divisions, SWD worked to improve coordination throughout the agency. Civilians and military personnel labored to ease tensions between headquarters and the districts, and to streamline the divisional role in program management and interpretation of new directives. By the mid-1990s, there were discernible improvements in redefining SWD's role in quality assurance, program management, regional interface among public agencies and private organizations, and command and control over the division's area of operations.

Through their efforts to provide such services to the region, SWD personnel helped refine the role of Corps divisions. In performing these functions, the people of the Southwestern Division proved their adaptability. In so doing, they reconfirmed the need for their services to the armed forces, the citizens of the Southwest, and the Corps of Engineers.

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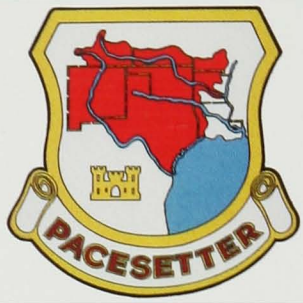
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